THURSDAY, MAY 8, 1884

A PLEA FOR A NATIONAL MARINE ZOOLOGICAL SURVEY

WHILST the influential meeting recently held at the Royal Society, for the purpose of founding a Society for the Biological Investigation of the British Coast, is still in the minds of naturalists, the present occasion is a fitting opportunity for the expression of opinions respecting the scope and aims of such an undertaking, as well as to suggest in what way zoological investigation in general may be more systematically directed than has hitherto been the case in this country.

The primary object of the newly-formed Society, as indicated in the resolutions passed at the preliminary meeting, is the establishment of a zoological station. This of itself is an important step in the right direction; and though much will depend on the thorough organisation and efficient management of the station, the hearty thanks of naturalists are already due to Prof. Ray Lankester for the energy and perseverance with which he has brought this desideratum within possible attainment. The establishment of a zoological station, however, or even of a number of stations at different parts of our seaboard, is not the only thing wanted. Neither should the maintenance of a single biological laboratory be the only aim of such a Society as the one proposed. Indeed it may be seriously questioned whether a Society is the best, or even a necessary, piece of machinery for the maintenance of a zoological station at all, excepting solely as a subscribing body, and even in this capacity its efficiency may prove inadequate. It is therefore to be hoped that the new Society will realise that there are broader and more extensive claims which zoology has a right to make in a country so peculiarly placed as Britain.

Few will deny that, notwithstanding the impetus given to the study of zoology during the last quarter of a century by the theory of evolution and the revelations of embryology, this branch of science appears in many respects to have been more backward than several of the kindred sister sciences in revising methods of investigation in accordance with the spirit of the age. Biology and morphology have of course made advances whose importance cannot be over-estimated; but it would seem that Zoology—in the wider sense—might well take a leaf out of the book of her much younger sister, Geology. Years ago, quite in the infancy of that science, national geology was placed upon a systematic basis by the establishment of the Geological Survey. The reason of that step is perhaps not far to seek. It stood mainly upon utilitarian grounds. The geologist was able to show that a knowledge of his science directly concerned the mineral wealth of the country, and that he offered as as it were the key to the then secret storehouses of coal, ores, and water, which were unmistakable synonymous terms for national wealth, advancement, and prosperity. It is quite unnecessary in the present place to do more than refer incidentally to the admirable manner in which the Geological Survey has fulfilled, and is still fulfilling, the purpose of its being. While constantly keeping in view the industrial applications of geology, it has at the same time never lost sight of the strictly scientific problems which the geological structure of the country presents in such abundance. Its success in both these departments may well point the argument that the zoologist has an equal share, and an equal power to assist, in the nation's welfare, besides possessing his own ample domain in science.

The insular position of this country naturally causes the sea fisheries and all that pertains thereto to be an important factor from a national and pecuniary point of view. The food, the habitat, the cultivation, the development, the enemies, and the diseases of fish all lie within the province of the zoologist; and it is to him alone that we can come for information on these questions, whereon the prosperity of our national fisheries depends, just as it is to the geologist that we go for direction as to the acquirement of the coal and ores that lie treasured beneath our feet, or as to the sources and quality of the water required for the supply of towns. On these grounds national marine zoology may claim an equally systematic method of investigation and an equal recognition as an important handmaiden to national wealth. Patriotism, as well as the desire for the advancement of human knowledge, would therefore urge with all possible earnestness the establishment of a national Marine Zoological and Physical Survey, whereby the fauna and the conditions of every portion of our coast should be carefully investigated. Apart from the unquestionable advantages that would thus be afforded to our fisheries, it is not too much to promise that by this means a greater amount of light would be thrown upon the life-histories of marine organisms, upon the variations of species, and the conditions upon which these depend, together with the solution of a greater number of important zoological problems than we could otherwise ever hope to attain. From a geological point of view, also, it is most desirable to have a better knowledge of the deposits now forming around our coasts. Other countries have already recognised these claims, and the fruition of their foresight is too well known to naturalists to need recapitulation here.

Such a scheme as the present naturally demands national encouragement and Government support. Many will of course say that the British Government is too much hampered and proverbially backward in assisting scientific projects to undertake what is here briefly indicated. May not, however, the want of success in obtaining assistance from Government be found to lie too frequently in the imperfect and partial manner in which application is made? Ministers and members of Government are too frequently "asked" in a private, unofficial manner whether support might probably be obtained for such-and-such an object; and should this happen to be one with which they are little conversant, it is only natural that the answer should frequently be unsatisfactory.

The establishment of a systematic and permanent Zoological Survey has, from its direct relation with a great national source of wealth, apart from its equally important scientific bearings, a logical claim which cannot be gainsaid; and it is scarcely to be supposed that a properly organised application would fail to be favourably received by the Government. In the event, however, of the prayer of such an application being rejected, the onus of neglecting an important British industry would obviously then rest on the shoulders of the Government; and scientific

men would at least have done their duty in urging its claims and pointing out whereby it might be protected and augmented. It unfortunately happens that up to the present time scientific men have brought no definite scheme or proposition of this kind directly before Government; and the onus of neglect may consequently in a certain sense be said to rest now at their door.

The honour of removing this responsibility lies directly within the scope of the newly-formed Society for Biological Investigation; for naturally no other body of men could more readily put themselves into communication with the various kindred societies throughout the kingdom, and thus obtain a unison of views upon this important subject. The next step would be to elect an influential representative deputation from the Society to wait upon the Prime Minister for the purpose of urging the appointment of a Parliamentary Commission to inquire exhaustively into the various subjects pertaining to a Zoological Survey.

THE ELECTRICAL CONGRESS OF PARIS, 1884

THE first Congress of 1881 has borne good fruit. It has not only brought about an *approchement* between electricians of all countries, but it has led to the adoption of an international system of measurement which will be in universal use. It is satisfactory to find that there are questions which can be amicably settled internationally. The Congress was divided into three Commissions which dealt with (1) electrical units, (2) atmospheric electricity and earth-currents, (3) standard of light. The first Commission virtually dealt with the length of a column of mercury of one square millimetre section which represented the ohm—it having been decided at the Congress of 1881 that this should be the unit of resistance. Many physicists had been working on this in different countries and on different methods. M. Mascart grouped the results in the following useful table:—

Methods	Experimenters	Column of Mercury in Centimetres
1. B.A.	British Association	104·83
	Rayleigh-Schuster	106·00
	Rayleigh (1882)	106·27
	H. Weber	106·16
2. Weber (I.)	Kohlrausch	105·81
	Wiedemann	106·19
	Mascart	106·33
3. Kirchhoff	F. Weber	105·02
	Rowland	105·79
	Glazebrook	106·29
	Mascart	106·33
4.	Röiti	105·9
5.	Fr. Weber	105·33
6. Lorenz	Lorenz (first)	107·1
	Rayleigh	106·24
	Lenz	106·13
	Lorenz (second)	106·19
7. Weber (II.)	Dorn	105·46
	Fr. Weber	105·26
	Wild	105·68
	Baille	105·37
8. Heat	Joule	106·22

From this it appears that the figures obtained by the different methods were—

B.A.	106·21
Weber's I.	106·14
Kirchhoff's	105·93
Lorenz	106·19
Weber's II.	105·47
Joule	106·22

The mean of which was 106·02, but 106 was taken as a round figure sufficiently near the truth for all practical and useful purposes. Hence the Congress decided that "the legal ohm should be the resistance of a column of mercury of one square millimetre section and of 106 cm. of length at the temperature of freezing," and a resolution was passed desiring the French Government to transmit this resolution to the different Governments, with a view of making its adoption international. It was decided that primary standards should be constructed in mercury, but that secondary coils should be made of solid alloys, which should be frequently compared among themselves and with the primary standard.

It was resolved that the ampère should be exactly 10^{-1} C.G.S. electromagnetic unit of current, and that the volt should be the electromotive force which maintained an ampere in a conductor whose resistance was the new ohm.

We can now congratulate ourselves upon having a scientific system of electrical units independent of any particular instruments or of any particular process. It is not absolutely exact. That is, the new ohm is not 10^9 C.G.S. units, but it is the nearest approach to it that can be practically attained. It will probably be known as the *Congress ohm*, to distinguish it from the true ohm (10^9 C.G.S.) or the B.A. ohm of 1864.

One subject of regret is that Prof. Rowland's measurements in Baltimore are not completed, and will probably not be ready before the end of the year. The United States Congress voted a large sum of money to enable this to be done. He is using a Planté secondary battery and employing three methods, viz. Kirchhoff's, Joule's, and Lorenz's. His well-known experimental skill has given much interest to this investigation of Rowland's.

The second Commission dealt with atmospheric electricity and earth-currents, and recommended that it was desirable to send each year to the Bureau International des Administrations Télégraphiques in Berne the reports that were collected in the different countries, so that they might be distributed to the different Governments.

The third Commission dealt with the standard of light, and it was decided, not without considerable opposition, that the unit for each simple light should be the quantity of light of the same kind emitted in a normal direction by a square centimetre of surface of fused platinum at the temperature of solidification, and that the practical unit of white light should be the total quantity of light emitted normally by the same source. This is a very unsatisfactory standard. It was accepted because there was virtually none other before. But it was obtained by only one observer (M. Violle); it is not portable; it is not even reproducible except at great expense, and it is so eminently impracticable that it is scarcely likely to be generally adopted. It is to be regretted that the British Association Committee on a Standard of White Light has not yet finished its work, but we may hope that at Montreal Capt. Abney will be able to give some results which will give us a better and more practical standard.

There was a universal consensus of opinion that the Congress had faithfully and earnestly done its work, and that the success of its labours and the rapidity of its action was due to the energy and ability of M. Cochery, the Minister of Posts and Telegraphs. Our English representatives were Sir William Thomson, Capt. Abney,

Prof. Carey Foster, Prof. Hughes, Prof. Fleeming-Jenkin, Mr. Graves, and Mr. Preece. The full text of the resolutions is as follows:—

"I. *Electric Units*, strictly so called. First Resolution: The legal ohm is the resistance of a column of mercury of a square millimetre cross-section and 106 centimetres in length at the temperature of melting ice. Second Resolution: The Conference expresses the wish that the French Government should transmit this resolution to the different States, and recommend an international adoption of it. Third Resolution: The Conference recommends the construction of primary standards in mercury conformable to the resolution previously adopted, and the concurrent employment of scales of secondary resistances in solid alloys which shall be frequently compared amongst one another and with the primary standard. Fourth Resolution: The ampere is the current the absolute value of which is ten to the power minus one in electro-magnetic units. Fifth Resolution: The volt is the electromotive force which maintains a current of one ampere in a conductor the resistance of which is one legal ohm.

"II. *Earth-Currents and Lightning-Rods.* First Resolution: It is to be desired that the results of observations collected by the various administrations be sent each year to the International Bureau of Telegraph Administration at Berne, which will make a digest of them and communicate it to the various Governments. Second Resolution: The Conference expresses the wish that observations of earth-currents be pursued in all countries.

"III. *Standard of Light.* Resolution: The unit of each kind of simple light is the quantity of light of the same kind emitted in a normal direction by a square centimetre of surface of molten platinum at the temperature of solidification. The practical unit of white light is the quantity of light emitted normally by the same source."

DR. JOULE'S SCIENTIFIC PAPERS

The Scientific Papers of James Prescott Joule, D.C.L., LL.D., F.R.S., &c. (London: Published by the Physical Society, 1884.)

OUR benefactors are oftentimes unrecognised! The writer of the present notice of our latest acquisition in scientific literature, takes credit to himself for having been the first to propose to Sir William Thomson the reprinting of his original papers. Seized with a great desire to possess those invaluable electrostatic papers, which, in 1867, could only be read in the original by those who were fortunate enough to have access to the *Cambridge and Dublin Mathematical Journal*, he urged that there must be many others by whom a reprint would be gladly welcomed. Thus was originated the reprint of the "Electrostatics and Magnetism."

The initiative being taken, we have now a second series from Sir William Thomson—part published, part in progress—intended to include all his mathematical and physical papers. Prof. Stokes also, under the influence of pressure and good example, has produced the first half of a reprint of his classical papers. Abroad we have collections of the papers of Prof. von Helmholtz and Prof. Kirchoff. Last at the present moment, but far from the least in importance or in general interest, we have the first volume of republished papers by Mr. Joule.

But what a debt of gratitude we owe to the Physical Society for its publishing enterprise—first for the publication of Prof. Everett's "Illustrations of the C.G.S. System," a book which has been helpful to every student of physical science; then for its graceful tribute to the memory of Wheatstone; and now for this fresh and most happy undertaking.

Before looking at the papers themselves, let us unburden ourselves of one or two remarks. The form of the book is admirable. The printing and the diagrams are all that can be desired. The accuracy of the author of the papers, who has personally undertaken the editing, appears in that there is scarcely a misprint to be found in the 650 pages. One serious want, and one only, we have felt, and it is this. Throughout the book there are many back references to previous papers. These references are given in footnotes exactly as they were given in the original papers, thus, *Phil. Mag.*, ser. 3, vol. xiii. p. 268. But what the reader of the book wants, nay absolutely requires, is the reference to the page of the reprint itself where the passage alluded to is to be found. May we be allowed to suggest this as an improvement for the second volume now promised?

To come to the papers themselves, almost one hundred in number. There is a considerable number of unconnected papers on a great variety of subjects, several on meteorological phenomena, six or eight on new instruments or modifications of instruments, a mercurial pump, an improved barometer, a new dip circle, a current meter, &c., in addition to his tangent galvanometer, and one or two others to which we will immediately refer more particularly; then we have a paper on utilisation of sewage; a note on the prevalence of hydrophobia; improvements in the common kite, &c.: all of considerable value. For the most part, however, the papers are on two or three classes of subjects very closely connected, and these are of superlative interest, containing, as they do, the germs, or rather affording the foundation, of the modern theory of energy.

Mr. Joule's papers are remarkable in form as well as in substance. Of mathematics there is scarcely a line: but what clearness, and depth, and penetration into the hidden things of Nature! Thus their interest is general to an unusual degree. To those who shun the labour of arriving at results by "chasing the ρ" through mazes of equations they are the perfection of clear exposition of fundamental principles. The mathematician, on the other hand, finds in them a model of concise expression, and results of experimental investigation stated in a form ready and convenient for being represented in mathematical symbols.

It is impossible within the limits to which these lines are necessarily confined to notice exhaustively the investigations themselves, or even the results arrived at. We must content ourselves with a brief reference to some of the most important.

The first subject which seems to have attracted the attention of Mr. Joule was that of magnetism and the electro-magnetic engine. His earliest papers are taken up with the description of novel forms of the electro-magnetic engine, and of experiments in this connection. In a very early paper he investigates the laws relating to

what is now commonly spoken of as the *back electromotive* force of a motor. In connection with these researches Mr. Joule obtained valuable results with regard to the construction and the efficiency of various forms of magnets, both permanent magnets and electro-magnets, and he was led also to improvements in the galvanometer which, in the form of the tangent galvanometer, he afterwards perfected.

These experiments led naturally to investigations on the connection between heat, electricity, and mechanical energy, and to a comparison between electricity obtained from chemical action and that obtained from magneto-electric machines, and also to an examination into the heat given out during electrolysis.

A paper of March 1841, on the heat evolved by metallic conductors of electricity and in the cells of a battery during electrolysis, is of special interest. It is here that the law is first announced that the heat developed by a current of electricity, whether through a metallic conductor or in an electrolytic cell, is proportional to the resistance and to the square of the current. It is proved that the whole heat generated by a voltaic battery is proportional to the chemical action which goes on in each cell of the battery multiplied by the whole "intensity" or electromotive force; and the localities at which the several portions of the heat developed in a compound circuit, are clearly distinguished, and the quantities of heat developed in each part are determined.

In this paper improvements in the galvanometer are referred to. A "degree of electricity," or unit-current, is defined as "the quantity of current electricity which is able to electrolyse a chemical equivalent expressed in grains in one hour of time." Hence the results in this paper, and in many others which follow and in which the same *degree* is used, are now easily reducible to absolute measure. His degree was somewhat less than two amperes, or one-fifth of the absolute C.G.S. unit. In this paper also he defines his *first unit of resistance*—a wire of copper ten feet long and 0·024 of an inch in diameter (about No. 23 B.W.G.); and it is curious and somewhat amusing to find that the copper wire which Joule used for this unit must have been preternaturally *bad!* If the wire had been of "conductivity" copper, such as is now universally insisted on, the resistance would have been 0·167 ohm. An easy calculation from Joule's results shows that the resistance must have been at least one-half more! It was not until the manufacture of the 1858 Atlantic cable was in progress that it was found that variations, not previously dreamed of as possible, were commonly to be met with in the conductivity of copper wire.

A most interesting paper on the electric origin of the heat of combustion, also in 1841, naturally follows that just referred to. It is in this paper that Joule determines the *electromotive force necessary to decompose water.* He finds it to be 2·8 of Smee's elements, and then proceeds to similar determinations for various chemical compounds used as electrolytes.

Space fails altogether for mentioning the multitude of interesting results, then perfectly unknown, which Joule brings out in these early papers. Many of them have played important parts in guiding and in assisting other investigators. We find tests recorded as to permanency of resistance coils. We have investigations of the resistance of electrodes of various materials in various electrolytic cells. Joule's early (1841 to 184[illegible]) determinations enabled Sir William Thomson in 185[illegible] to calculate in absolute measure the electromotive force of a Daniell's cell. He found it to be 2,507,100 British absolute units or 1·0739 volt! It is doubtful whether we are assured of a better result at the present day.

We must notice next the series of papers containing Joule's researches on the dynamical equivalent of heat, unquestionably the most important of all his investigations. The complete and successful prosecution of this investigation belongs to Joule, and to Joule alone. The methods are his; the carrying out of the experiments is his. The result will ever be known under the honoured name of "Joule's equivalent."

It is interesting to notice the first germ of the idea, and to be enabled to follow, from its commencement to its conclusion, the series of experiments which gradually brought out the result with which we are now so well satisfied.

In a paper dated January 24, 1843, we find the first mention of the idea as follows:—

"The magnetic electrical machine enables us to convert mechanical powers into heat by means of the electric currents which are induced by it. And I have little doubt that, by interposing an electro-magnetic engine in the circuit of a battery, a diminution of the heat evolved per equivalent of chemical change would be the consequence, and this in proportion to the mechanical power obtained."

A note dated February 18, 1843, is as follows:—

"I am preparing for experiments to test the accuracy of this proposition."

The results of the experiments alluded to in the note just quoted were given to the British Association at its meeting at Cork, in a paper read on August 21, 1843, "On the Calorific Effects of Magnetic Electricity, and on the Mechanical Value of Heat." The experiments were made by rotating "an electro-magnet immersed in a vessel containing water between the poles of a powerful magnet, to measure the electricity thence arising by an accurate galvanometer, and to ascertain the caloric effect of the coil of the electro-magnet by the change of temperature in the water surrounding it."

Permanent steel magnets were first employed for producing the magnetic field, and afterwards a huge stationary electro-magnet was used for this purpose. The writer of the present notice well remembers the interest with which this great rough magnet and its accompaniments were viewed, by some of the foreigners who visited the Loan Collection of Scientific Apparatus at South Kensington in 1877.

Joule's conclusion, given to the British Association at this time was that the mechanical equivalent of a water pound-degree Fahrenheit of heat was 838 foot-pounds of work. In a postscript to this paper, of date August 1843, he says:—

"I have lately proved experimentally that *heat is evolved by the passage of water through narrow tubes.* My apparatus consisted of a piston perforated by a number of small holes working in a cylindrical glass jar containing about 7 lbs. of water. I thus obtained one degree of heat per pound of water from a mechanical force capable of raising about 770 lbs. to the height of

one foot, a result which will be allowed to be very strongly confirmatory of our previous deductions."

In 1844 we have a paper communicated to the Royal Society on "Changes of Temperature produced by the Rarefaction and Condensation of Air." This paper was not accepted by the Royal Society for its *Transactions*, and the *Philosophical Magazine* had the honour of publishing it! In 1845, in a paper read before the British Association, he describes experiments made by stirring water with a "sort of paddle-wheel" in a "can of peculiar construction;" and in 1846 this was followed by an important paper on "Heat disengaged in Chemical Combinations."

It was, however, in 1849 that his celebrated paper "On the Mechanical Equivalent of Heat" was communicated by Faraday to the Royal Society. This was the first of Joule's papers which was communicated to and *not* rejected by the Royal Society, and *it* was rewarded by a Royal Medal! In this paper he describes experiments (1) on friction of water; (2) (3) friction of mercury, two series of experiments; (4) (5) friction of cast-iron, two series. From all these he concludes:—

"(1) *That the quantity of heat produced by the friction of bodies, whether solid or liquid, is always proportional to the quantity of force expended; and*

"(2) *That the quantity of heat capable of increasing the temperature of a pound of water* [*weighed* in vacuo *and taken at between* 55° *and* 60°] *by* 1° *F. requires for its evolution the expenditure of a mechanical force represented by the fall of* 772 *lbs. through the space of one foot.*"

In 1867 a report was communicated to the British Association through the Committee on Standards of Electrical Resistance, containing the results of fresh experiments on the dynamical equivalent of heat. Finally, at the desire of this Committee, and aided by funds placed at his disposal by the British Association, Mr. Joule undertook a complete redetermination. This was commenced in 1870, and his report was given in 1878. Here is his conclusion, stated in the last two sentences of the present volume:—

"The equivalent at the sea-level and the latitude of Greenwich will therefore be 773·492 foot-pounds, defining the unit of heat to be that which a pound of water, weighed by brass weights when the barometer stands at 30 inches receives in passing from 60° to 61° F. With water weighed *in vacuo* the equivalent is finally reduced to 772·55."

It is impossible for us to do more here than mention some of the other papers contained in this volume. Perhaps among those which are of highest importance we should refer first to a short paper "On the Theoretical Velocity of Sound," in which outstanding difficulties are cleared up, and deductions as to the true relation between the specific heat of air, volume constant, and the specific heat, pressure constant, are brought forward. We have also important experiments on "Some Amalgams," in which their mode of production and characteristics are dealt with. A paper "On Surface Condensation of Steam" was largely conducive to the great improvement which the substitution of this method, for condensation by injection, has realised in the condensing engine of the present day.

In connection with his very earliest work Joule gave special attention to the construction of thermometers. He was the first to produce accurate thermometers in England, as Regnault did, just about the same time, in France. Joule's thermometers were made for him by Mr. Dancer of Manchester. In 1867 we have a paper "On the Alteration of the Freezing-Point," giving the results of the observations of five and-twenty years on this curious phenomenon. In the present volume the paper is supplemented by observations carried down to December 1882.

We mention, lastly, his papers describing experiments to test the brittleness supposed to be imparted to iron castings by frost—experiments which, so far as they go, negative altogether the popular idea on the subject; and with this mention we must take our leave of the volume, expressing once more our deep appreciation of its value, and earnestly hoping for the speedy appearance of its promised companion.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

Long or Short Fractions for Great Natural and National Standards—Earth's Axis of Rotation

IN the two last numbers of the *American School of Mines Quarterly Journal* the learned President Barnard of Columbia College, New York, has involuntarily opened a question of far wider interest than the particular one with which he set out. For on his page 120 there stands the following remarkable statement:—

"The length of the polar axis of the earth is a quantity which may with strict truth be pronounced to be, up to this time, absolutely unknown."

Now if that really be so, the peoples of every civilised country on the face of the earth, who have been taxed during the last hundred years to the extent of millions and millions for the support of magnificent arc-of-the-meridian measuring establishments, have some right in common sense to rise with revolutionary wrath, and demand how those enormous sums of their money, given to determine the size and shape of the earth, have been expended. And when shall we know the far greater distance of the sun!

But the statement can only be true on some private interpretation which is needless to inquire into; for when we take the various lengths of the earth's axis of rotation as determined in modern times, and collected by President Barnard himself from very diverse sources indeed, we find them all to be coincident to four places of figures at least. And considering that for some other most important natural standards the world is apparently content with a certainty of two places of figures only, the officers of the several trigonometrical establishments of all the countries of Christendom deserve high praise, rather than blame, for the results they have succeeded in bringing out.

The mean of their last five measurements, as given by President Barnard for the polar axis of the earth, is

500,492,732·8 British inches,

the ten-millionth part of which is evidently

50·04927328 British inches;

though *he* has chosen to bring it out as a very different quantity indeed, viz. 49·273 British inches.

But the rather important point now to be discussed is, whether in practical use as a standard of measure, either on paper or for mechanical work, we should attempt to realise that long fraction; or be content with the

50·05 British inches,

at which, as quoted by the President, I had years ago ventured to assume the said ten-millionth of the earth's axis of rotation.

In place of merely, and perhaps vainly, *theorising* on the sub-

ject, let us look to the growth of modern opinion on a much older question, but connected with the same axis of rotation, viz. the number of solar days in a tropical year; reckoned now to be $365 \cdot 2422414 \pm x$, but assumed in the old Julian year = $365 \cdot 25$.

Pope Gregory's reformation of the calendar, by introducing the former (or something like it) in place of the latter quantity, caused sufficient disturbance to all the ordinary affairs of men in every nation when it was first adopted; and has some arguments which may be alleged in its favour still.

But if I read aright a recent tract by so consummate a physical astronomer as Prof. Simon Newcomb, he holds that the Gregorian alteration has done so much more harm than good, being quite a needless refinement, and is so totally unsuitable to calculations in physical astronomy, compared with the Julian year, that civilised nations should, and presently will, return to that year and reckoning, or "Old Style,"—leaving a few curious computers, whom it may concern, to prepare tables of corrections where they are absolutely required for their own abstruse and recondite purposes. C. PIAZZI-SMYTH

15, Royal Terrace, Edinburgh, April 26

The Ancestor of the Dipper (*Cinclus*)

IN NATURE for April 3 (vol. xxix. p. 524) the Duke of Argyll desires Mr. Romanes to prove "that the dipper once had an ancestor which began to dive in water, &c." The Duke well knows that such ancestry cannot be exhibited, but seems unaware that there are other *land* birds that are *divers* besides the dipper (*Cinclus*). I have often seen the winter wren dart or dive through a sheet of water, and remain in the damp and dripping space behind the little cascade. The water-thrushes (*Seiurus*, sp.) all wade in water, and often, seeing minute mollusca on the bottom of the stream, plunge both head and neck beneath the surface; so that, often for several seconds, a large part of the body is submerged. Now, these birds, like the winter wren, still have the plumage "pervious to water, and so *are* liable to be drenched and sodden"; but they have also the faculty of giving these drenched feathers such a good shaking, that flight is practicable a moment after leaving the water. Swallows, too, are often seen flying in and through spray and thin sheets of falling waters, yet with no detriment to their flight power. Certainly the water-thrushes or wagtails (*Seiurus ludovicianus*, *auricapillus*, and *noveboracensis*) have taken many preliminary steps towards becoming as aquatic as the dipper (*Cinclus*), and the winter wren, and even Maryland yellow-throat, are not far behind. The Duke can scarcely derive any comfort from the dippers; Mr. Romanes can. CHAS. C. ABBOTT

Trenton, New Jersey, U.S.A., April 18

Double-storied Houses and Concave Roofs

IN your issue of January 31 I notice a review of Mr. Im Thurn's book on the Indians of Guiana, in which attention is called to the manner in which a pile dwelling may be converted into a two-storied house, and Prof. Moseley's suggestion that the Swiss châlet did so originate is quoted, the general impression intended being apparently that this, in the majority of cases, is the origin of a double-storied dwelling. Now in that portion of the Himalayas lying south of the snowy range, to which my personal experience is confined, double-storied houses are almost universal, the lower story being used as a cattle-shed, the upper as a dwelling; at the level of the floor a platform is carried out from the building on one side at least, usually on three, or, if the house stands clear of the hillside, on all four sides. The only means of access to this platform and the upper story is by a ladder or flight of steps—it is difficult to say which it should be called—but it consists of the trunk of a tree split in half on the flat surface of which a series of notches are cut to give foothold; this is placed in a sloping position leading to the outside edge of the platform, or if, as is often the case, the platform is inclosed by boarding, through a hole in the floor. It will be seen that this is a principle of construction such as might easily have descended from a pile dwelling, and yet I cannot believe that this is the case; my reasons are: (1) there are no lakes in the Himalayas in which the habit of building on piles could have been acquired; (2) the houses are built of dry stone, strengthened at intervals by timber frames, these frames being without exception horizontal, and built into the wall in courses, such a thing as a vertical post being unknown, while had the style of structure descended from a pile dwelling, some trace of the piles would probably have remained, and the house been built on vertical posts whose interstices were filled in with stone, &c.; (3) though two stories are the rule, it is by no means a universal rule: the temples are frequently three, and occasionally four and even five stories high, while those of the natives who are rich enough to afford it build three-storied houses, the ground-floor being used for the cattle, the intermediate one as a storeroom, and the upper one as the dwelling. On the other hand, the Kolis or Koltas, an aboriginal race who are as a rule the servants, or practically slaves, of the so-called Brahmin and Rajput land-owners, generally inhabit a single-storied cabin, but where these Kolis themselves own land and cattle, they, too, have double-storied houses. The true origin of this style of building lies, I fancy, in the fact that stone or wooden slabs are practically the only available roofing material, and the preparing and collecting these, not to mention the timbers required, forms a very serious part of the labour involved in building a house, and it is consequently an advantage to make one roof cover both the cattle and their owner rather than to undertake the labour and expense involved in two separate roofs.

In this connection there is a point to which I would wish to call attention. When first entering the Himalayas I was struck by the fact that, whereas the roofs of the villagers' houses were made with a single straight slope from ridge to eaves, those of the temples were as a rule steeper near the ridge, so as to present a concave outline, and as the ends were usually ornamented with deep weather boards fringed with pendent wooden ornaments, while the corners often had what can best be described as a wooden tassel, the appearance of the whole was decidedly Chinese; as I worked higher up into the hills, towards the region of the deodar, the origin of this construction revealed itself. Where deodar is abundant the roofs of the common houses, as well as of the temples, are made of split planks the whole width of the tree, and from 6 to 8 feet long, the ridge being made water-tight by a coping cut out of a single deodar-tree shaped into a ridge above, while in the lower side a V-shaped group is cut. If the row of planks next the ridge were set at a low angle, it might be difficult to fit this coping; but when the angle of the slope is high, the fitting is easier, and besides the beam by its weight grips the planks of the opposite slopes and holds them together effectually without the need of nails, a consideration of probably far greater weight at the time when this method of construction originated than at the present time. Thus the origin of the high slope near the ridge is explained, but to carry this high slope down to the eaves would necessitate the use of an inordinate amount of material, and so the second row of planks is arranged with a gentle slope; in those rare cases where the roof is large enough to require three separate rows of planks, the middle one is arranged generally with a slope intermediate between those of the two marginal ones, and the roof assumes a concave form. As deodar gets scarce the first roofs in which it disappears are those of the villagers' houses, and it is invariably the lower or gentle slope that is the first to be roofed with stone; then this spreads on to the steeper part of the roof, but here the slope has to be lessened or the slates nailed on. Where roofing slabs can be obtained, large and well-shaped, the latter alternative is adopted, and merely the deodar coping remains of the original wooden roof; as a last stage this too disappears, and the ridge is made water-tight by carrying the slates of one slope over the edges of those of the other. This style of roof, however, only persists where roofing slabs are obtained in such abundance and of such size that they can be cut to the desired shape; where slates are only procurable of small sizes and irregular shapes, the concave roof is soon found to be inapplicable, the higher slope near the ridge disappears, and the roof assumes the form of a single gentle slope, but in the temples the archaic form survives. I have called attention to this concave outline of roof because a similar concavity of outline in Chinese roofs is commonly said to be a survival from the time when the Chinese dwelt in tents; this can hardly be the true explanation, for, as Fergusson has pointed out, the Tartar tents, and those of all nomads with which I am acquainted, have a convex and not concave outline. I do not know whether there are in China any trees from which roofing slabs of good quality are or could be made, nor have I at present means of access to any books by reference to which I could settle this question, but if such be the case it is more probable that the concave outline originated as I have indicated above than in the manner suggested by Fergusson in his book on Eastern architecture.

This letter has already run to great length, but in conclusion I should like to add a few words anent the wooden ornaments already referred to. They are usually turned in a lathe, and in shape are not unlike the ninepins of our childhood, but the knob at the top is originally larger in proportion, and continued upwards into a tenon; the knob is then carved away so as to leave two interlocking loops, and the tenon is fitted into the weather board. At the corners of the roof there are often pendent disks of wood fringed with these ninepins, so as to form a sort of wooden tassel. These would answer well for a rude copy of bells which similarly fringe the roofs of the Chinese pagodas, and it is possible that there is a direct connection between the two, but in any case their association with a concave roof is at least a remarkable coincidence. B. D. OLDHAM

Camp Matil in the Himalayas, April 9

The Recent Earthquake

SINCE the earthquake of Lisbon in 1755 troubled the waters of the fish-pond, called Peerless Pool, in the London City Road, it has been a well-known fact that earth-waves had a direct influence in producing an alteration in the level of waters inland, as well as in producing tidal waves sweeping the coasts. The earthquake of Tuesday, April 22, has produced a marked, and, so far, permanent, change in the level of underground waters in the district most affected by the shock, but how far this influence extended there is not yet evidence to show, for, judging by past experience, it may probably prove that springs have increased in volume and the underground water-levels have been raised over the whole area affected by the recent shock, which includes the district lying between Broadstairs and Bristol, 165 miles from east to west, and from Spilsby to Ryde, 170 miles from north to south, and possibly beyond it. It will be of especial interest to know whether the Wealden area, which, as Mr. Topley has pointed out, was free from the more direct influence of the shock, experienced any rise in its underground waters.

At Colchester the water supply is derived from a deep artesian well in the chalk, the supply from which has slightly lessened during the past few weeks, necessitating the lengthening of the suction pipes; and the necessity of still further lengthening them was under discussion, when the Water Committee were agreeably surprised to find that the earth-wave of the 22nd had caused an increased flow of water, and a rise in the water-level of 7 feet, which has so far been maintained.

Earthquakes were described by Mallet "as the transit of a wave of elastic compression." This motion at Langenhoe produced fissures in the gravel walks of the vicar's garden, and at West Mersea opened a fissure a rod in length, which for a short time took off the springs which supply the village with very pure water, and when, after an interval, the pools in which the water accumulates were again full, it was found to be red and thick, and in some of them to be strongly mixed with chalk.

At Bocking the height of the water in Messrs. Courtauld and Co.'s well has been taken weekly for some years; the surface of the well is 137·07 feet above the mean sea-level, and the heights given represent the number of inches the water rises above the surface; the results are very remarkable, the highest previous reading being on Easter Monday, 1883, when it was 19 inches.

The following is the weekly record of the level of water in Messrs. S. Courtauld and Co.'s well, Bocking, Braintree, Essex. The observations are made at 6 a.m. on Monday mornings; no water is drawn from the well on Sunday.

1884	Inches		Corresponding period 1883	Inches
March 31	14½		April 2	13
April 7	15		,, 9	12
,, 14	12½		,, 16	13½
,, 21	12		,, 23	14½
,, 28	31½		,, 30	16
,, 29	32¼		—	—
,, 30	34		—	—
May 1	34	Daily.	—	—
,, 2	36		—	—
,, 3	38½		—	—
,, 5	42		May 6	15

The readings being weekly, and the earth-wave occurring the day after the record was taken, unfortunately a week elapsed before the remarkable rise was ascertained; after that the readings were taken daily, showing a continued steady rise in level.

These facts tend to show that the recent earth-wave has caused the fissures to open, and to permit a freer circulation of water, and that consequently the "cone of exhaustion" has been filled up with water; and that the only example of this effect so far received should be from chalky districts is not surprising when it is remembered, as Prof. Ansted pointed out, that, though the chalk absorbs water freely, it parts with it slowly, the water derived from chalk-wells being due more to water travelling in the joints and fissures than to the water stored in the chalk itself. It would appear probable that when the increased volume of water now running off, through the enlarging of the sectional area of the fissures, is again lowered by pumping, the old artesian gradients will be resumed, and that the present increase will be only temporary.

As Secretary of the Underground Water Committee of the British Association, I shall be glad to receive any further information on these phenomena. C. E. DE RANCE

Museum, Jermyn Street, S.W.

FROM recent observations I have concluded that the seismic vertical was at or near Dr. Green's house, close to the Strood or Causeway which connects the mainland of Essex with Mersea Island. The house was built in 1860, and is therefore new. I may here observe that (as I hinted before in former letters) the modern, cheaply-built cottages were not so much affected as the more ancient ones. The chimneys, walls, &c., of the latter were invariably destroyed, damaged, or cracked—the former seldom so. I was much surprised at this. The first thought naturally was that these "jerry-built" houses would be shaken down like a pack of cards. Is it that their very looseness of structure is in their favour, as compared with the stronger-built cottages of two and three hundred years ago? I have somewhere seen that in earthquake-visited centres the houses most secured from destruction are the loosely-built, low edifices. One can speak plainly on this matter, as no premium is required to encourage the development of "jerry-building."

Dr. Green's house is literally split and cracked in all directions, and the splits and cracks are the most vertical of any to be seen. The entire building was twisted on its foundations. At the south-west corner this is visible to the amount of about one inch and a half. Dr. Green informed me he was lifted up, as if from behind, and shot violently forward.

A friend of mine remarks (and I noticed the same fact in my note-book, but omitted inclosing it in my last communication) that the railway cutting at Wivenhoe appears to have broken the continuity of the undulations, for the houses contiguous to it are comparatively uninjured.

A noteworthy fact in connection with the recent earthquake, to which I can personally testify, and which appears to be the general experience of all the most trustworthy observers I have come across, is that the sounds or noises preceded the oscillations for an appreciable period of time. Mallet's experiments showed that the shock of an explosion travelled through wet sand at the rate of 951 feet per second. In Ipswich we are situated chiefly on drift sands and London Clay, and allowing that the earthquake shocks travelled through these strata at a more rapid rate, it is not likely to have been much more rapid. As sound travels at the rate of 1118 feet per second, it is very probable that the noise accompanying the earth-movements preceded the oscillations

Mr. Wilkins, the well-known yacht-builder at Wivenhoe, tells me he was standing at the time the earthquake occurred in the yard, and his first impression was that a new yacht he was looking at was heeling over, and he called out so to his workmen in the shop close by. Then followed the crash of the tall chimney and the rending of the walls. The workshop has an upper floor, with windows on each side, and, as he stood in the yard, Mr. Wilkins says the oscillatory waves were such that he was enabled to look right through these windows, so as to see the falling chimneys of the buildings on the other side. He calculates that there must have been a rise and fall of the ground of 2 feet 9 inches to have enabled him to do this.

On Saturday, May 3, the members of the Ipswich Scientific Society made an excursion to Langenhoe and Peldon, and Mr. Henry Miller, C.E., the honorary secretary, kindly took the following exact measurements of the rents seen in a building adjoining Peldon Mill. There are two of them, succeeding each other at a short distance, and they pass through the brickwork at an angle of just 30°. At the gable end of this building there is

another rent in an opposite direction at an angle of exactly 32°. The brick shaft of the mill stands by itself, and is about 40 feet high. The upper part, ten feet from the top, is broken right through, evidently by the swaying motion, and is twisted round on the lower part one inch and a half towards the south-east. The size of the chimney at this part is 3 feet 9 inches square.

In view of Mr. Topley's suggestion that the earthquake may have some connection with the underlying ridge of Palæozoic rocks, it would be interesting to know if any shocks were felt in the Boulonnais and the Ardennes. J. E. TAYLOR

Ipswich Museum

AT the Cross Farm, East Mersea, on April 25, I was shown in the garden two places where water, it was said, spouted up shortly after the shock on the 22nd. They were about ten yards apart on a freshly dug piece of ground on a slight slope, and the woman who lived in the house close by informed me that after the shock she had observed water spouting out from them, and that it continued to do so until after her dinner, which was at one o'clock, when it ceased. There was enough water she said to cause a small stream to run down from each place towards her house, where they formed a puddle; her husband tasted the water and told her it was brackish. There was still evidence of the truth of this statement: the earth at each spot was damp, as was also a small channel which the water had made running down the slope. It appeared as if a small underground water-pipe had burst and the water had been forced above the surface. Cross Farm, I believe, is about a quarter of a mile from the sea, and perhaps twenty feet above its level. EDWARD NEWTON

Lowestoft, May 5

THIS village lies partly on the lowest beds of the Chalk, and partly on the Gault; it is between N. lat. 51° 49' and 51° 50', and W. long. 0° 40' and 0° 41'. The shock was felt at the church, and at two cottages where are invalids in bed. The church is on rising ground at the edge of the chalk platform which lies below the Chilterns, some two miles away from them. I was on the scaffolding erected for repairs to the church. At a little past nine—it could hardly have been later, I think, than 9.15, if so late—I felt the church give what seemed like a fierce shudder. This seemed to begin on the east, rather to north, and travelled westwards nearly. By shudder I mean that a sort of vibration began, which almost instantly increased in intensity, reached a climax, and then rapidly decreased and died away. It seemed to me to begin slightly north of east, because I remember feeling (for what reason I can hardly say) that the cause was hidden from me behind the east end of the church. I was on the south side, some eighteen feet from the south-east corner. A moment after a whirlwind followed, which began, as I find, near the top of the slope north-east of the church, and followed the churchyard wall which bends round the churchyard to south-west. In a cottage on the junction of the Chalk and Gault (or very near the junction), according to the result of inquiries I have made of an invalid there, the pictures on a wall lying north-west and south-east waved from and to the wall, but seemed also to move along it somewhat, *i.e.* north-west and south-east. Flower-pots on a table rocked in a direction almost east and west, and a window facing the south-east shook; her bed also, lying north-west and south-east, waved, and seemed as if giving way. This took place, she says, a little after nine. In a cottage on the Gault where another invalid was lying, a window facing south-west rattled, a picture shook on the wall on which it is fixed, and the bed, lying south-east and north-west, also waved. This was, she thought, at nine, but the time must have been later. She noticed that the wind was still. No noise was heard except the clatter caused by the rattling of the buildings; but at a mill on the Icknield Way, near Tring, lying at nearly lat. 51° 48', and long. 0° 40', a rumbling was heard. FREDERICK W. RAGG

Masworth Vicarage, Tring, May 6

Black Rain

THE following paragraph from the *Field* of May 3 will probably interest those of your readers who have seen my note in the last number of NATURE (p. 6):—

"Black Rain.—Yesterday afternoon (April 28) a violent thunderstorm raged over the district between Church Stretton and Much Wenlock. Torrents of rain fell, seemingly a mixture of ink and water in equal proportions. One old man here says he never saw anything like it but once. I certainly never saw such a coloured rain, and I intend to have a bottle of it analysed. Even this afternoon the little brooks are quite black, and the ruts in the roads look as if ink and water had been poured into them.—Rev. R. I. BUDDICOMBE, Ticklerton, Church Stretton."

An analysis of the rain which fell at Stonyhurst showed that the impurity was almost entirely carbon. S. J. PERRY

Stonyhurst Observatory, Whalley, May 4

The Remarkable Sunsets

BECAUSE of the volcanic hypothesis that has been proposed to account for the red sunsets of the past fall and winter, other instances where similar phenomena have been seen after like eruptions are of interest.

Graham's Island, which arose off Sicily in 1831, attracted attention from July 19 to August 16, but was most active on August 7, according to the account given by John Davy in the *Philosophical Transactions* for 1832. The same writer says (p. 252):—"In the month of August a singular appearance was witnessed in the heavens, many evenings successively, both here and in Sicily. Soon after sunset the western sky became of a dark, lurid red, which extended almost to the zenith, and continued gradually diminishing in extent and intensity even beyond the limit of twilight."

A few days after this eruption, August 11 and 12, on the clearing away of a hurricane, the sun appeared blue at the Bermuda Islands (*Amer. Journ. Sci.* xl. p. 323); on August 13, 14, 15, at Mobile, in the southern part of the United States, the rays of the sun were pale blue or violet, varying to sea green (*Amer. Journ. Sci.* xxi. p. 198).

In the month of October the sunsets were prominent enough in the vicinity of Washington to attract popular inquiry. At Alexandria, Virginia, October 12, the heavens continued to reflect a very red light for a long time after the sun had set. October 13, at midday, the sun had a silvery appearance, and its rays gave a ghastly appearance to the countenances of persons. Between 3 and 4 p.m. it appeared greenish blue (*Niles' Register*, October 1831). L. G. CARPENTER

State Agricultural College, Lansing, Michigan, U.S.A., April 17

IT may interest readers of NATURE to learn that on the occasion of a rain-storm at 5 p.m. on the 26th ult. at Crowle, an agricultural village a few miles eastward of this city, the rain-water was so greatly discoloured and loaded with an ash-like matter as to present, until after subsidence, a deep black hue, when caught in vessels placed for the purpose. Again, on Saturday last, the 3rd inst., on the occurrence in this city of rain-storms during a half gale from the north-west, there remained after the storms, on the panes of windows exposed to the north west, a considerable film of dust which had fallen with the rain. While writing it may be mentioned that the phenomenon described as red sunrises and sunsets has prevailed here, before and after sunset, ever since November 9 last; of late, in gradually decreasing tone and variety of colour, and extent of sky area. The coloration at this date is of a russet hue, and there is a steely glare. J. LL. BOZWARD

Worcester, May 5

Rotating Thermometers

IN reference to the Froude thermometer, to which attention is drawn in your last number (p. 6) by Mr. Hazen, I feel confident that if its merits were better known it would be universally employed, not only as insuring among all observers absolute uniformity in the record of the temperature *of the air*, but as affording the only satisfactory means of determining the degree of saturation by means of the wet and dry bulb. Nothing is more perplexing to the meteorologist than the selection of his screen and of an appropriate site. The system of whirling a thermometer rapidly through the air effectually dwarfs all external influences from the rapidity with which renewed particles constantly impinge on the bulb, and it is well known that in the case of the wet bulb the indication is greatly affected by the presence or absence of wind. I found this to be practically the only means of determining the temperature and humidity in a steamer at sea. The only objection was the inconvenience and risk of whirling small thermometers on a string,

and the difficulty of reading without affecting their record; but this I completely got over as explained in my "Visit to South America," 1878, by using a simple whirling table, on which the thermometers were fixed, the reading being effected by bringing them in succession under a plate of glass covering part of the circumference of the table. Nothing can exceed the simplicity of such an arrrangement, which is almost independent of position, and with *small* thermometers affords a uniformity and accuracy impossible of attainment with a fixed thermometer, as it becomes a repeating instrument by a few extra turns of the table, thus insuring freedom from error of observation. I have used this system for many years with most satisfactory results.

EDWIN CLARK

Science and the Public Service

WHILST sincerely regretting the new scheme of openly cutting down the science marks in the army examinations, I think it is not so much the low maximum of marks supposed to be attainable which is discouraging the science subjects, as the low marks actually given at all Government examinations (excepting the Indian Woods and Forests) to any one who is so unwise as to take up natural science. To take, as an example, the Indian Civil Service marks of last year. While in French and German, each of which is a 500 subject, more than 30 per cent. of the candidates obtained over 200 marks; in chemistry, which is also a 500 subject, only two out of thirty-two, or 6 per cent., scored over 200. The marks in the other subjects included in the fatal column of natural science are equally low. Now I do not think that any one will maintain that science is not properly taught at Clifton, Dulwich, &c., yet in French and German a boy has every chance of obtaining 100 marks more than in chemistry (the highest marks last year were—chemistry 229, French 325, German 347). Two possibilities present themselves: either the clever boys will not take up science subjects at all owing to the low marks persistently given, or the examiners expect more chemical knowledge from a boy of eighteen (who must take mathematics or classics, English, &c., in addition to chemistry) than he can possibly acquire. I trust that examiners may be induced to seriously consider the last possibility.

F. C. S.

THE ROYAL CORPS OF NAVAL CONSTRUCTORS

BY an Order in Council of August last this corps was established; an Admiralty Circular of November last published the details of the new arrangements; and the result of the first examination for the grade of "Students in Naval Construction" has recently been announced. An important change has thus been made in the entry, training, and promotion of the professional officers upon whom devolve the responsibilities connected with the design and construction of ships for the Royal Navy; yet little public interest has been evinced. There can be no dispute, of course, as to the great importance attaching to the maintenance in the highest state of efficiency of the constructive department of the navy. Shipbuilding is making such rapid strides that all who have to take part in its developments, whether for war or for commerce, require a highly scientific as well as a thoroughly practical education, if they desire to keep in the forefront of progress. And for modern war-ships with their high speeds, heavy burdens of armour and armament, and liability to damage in action, specially difficult problems continually present themselves, the solution of which is only possible by means of scientific procedure. Recognising these facts, it may be well to make a brief statement respecting the new Constructive Corps, and to indicate the manner in which its creation may be beneficial not merely to the public service but to the mercantile marine.

It is only proper to remark at the outset that the Lords Commissioners of the Admiralty have hitherto been the chief patrons of the scientific education of shipbuilders in England; and to their generosity has been due the existence of the only establishments in which the higher training of naval architects was provided for. Early in the present century (1811) the first School of Naval Architecture was established in Portsmouth Dockyard, and continued at work for more than twenty years. It was established in consequence of the absolute necessity for opposing to the well-trained French naval architects men of equal education and ability, who could not be found at that time in our naval service. Ship-designing was clearly in a very inferior position here, when no shame was felt in building servile imitations of vessels captured from the French. In 1832 this school was abolished, and for sixteen years there was no training establishment of the kind open for English students. But during that interval men educated at Portsmouth occupied important positions both in the Royal Naval service and in private establishments, helping to maintain our national reputation. In 1848 a second school was opened at Portsmouth, on a much more modest scale, and destined to have a shorter life, for it lasted only five years. That brief period sufficed, however, to produce a number of men still holding some of the highest positions in the profession. Another interval of ten years elapsed, and then the Royal School of Naval Architecture was opened at South Kensington, the Admiralty giving it large support, although it aimed at educating other than Admiralty students. Since 1864 there has been no interruption in the good work, although in 1873 the establishment at Kensington was broken up, and the Admiralty section of it transferred to the Royal Naval College at Greenwich. There, as at Kensington, all comers are welcomed if they possess sufficient preliminary training, and private English students, as well as foreigners, have opportunities for instruction afforded them as good as those which the Admiralty provide for their own students. By the munificence of Mrs. John Elder the University of Glasgow has had a Professorship of Naval Architecture recently established, and the classes will, it is understood, commence work this year. But up to the present time the Royal Naval College affords unrivalled opportunities for instruction, and may challenge comparison with any similar institution in Europe.

By means of the very excellent training schools in the Royal dockyards, and the large field of selection from among the apprentices, the Admiralty have been able to secure a continuous supply of well-prepared students for the higher training at Kensington or Greenwich; and thus have obtained the educated naval architects required for the public service. Nor is this all that has been done. A very considerable number of the trained men have passed from Admiralty employment into private establishments, where they have done and are doing good work.

It may be asked, in view of these results, why change a system which has worked so well? The answer is twofold. First, there were grave objections to the continuance of the restrictions imposed by the regulations for first entry into the service. Second, there was not proper recognition of the special training which a student had received when he passed out into actual work, nor any guarantee of a subsequent career. These points require brief explanation.

Although the Admiralty so fully recognised the value of scientific training for its naval architects, and made provision for it, yet for half a century they maintained regulations which necessitated the first entry into the service being made either as an apprentice or as a working man. A few exceptions may be quoted: but the general rule was as stated. The result of this arrangement was that, with few exceptions, candidates for entry came from the working classes; and there was no attraction into the service of the sons of persons in good social positions, such as very commonly become pupils of civil or mechanical engineers. This was obviously a matter which required alteration. The competition for entry was absolutely free, no doubt; but it was surrounded by conditions which

made the real field of selection narrow, and did away with many possibilities of attracting well-educated youths into the service.

Competition was of the essence of the whole system—unlimited and fierce. There was an open competition for entry as apprentice, with probably ten times as many candidates as there were appointments; then from amongst each year's successful candidates—perhaps thirty or forty in number—three only could reach the Naval College after five or six years' work and frequent examinations. Supposing the College course successfully passed, and the student launched on his professional career as a fully certificated naval architect, he then only began a fresh series of competitive examinations on the result of which depended his future promotion. This was a second objection to the old scheme: it was much the same as if a wrangler were called upon to begin work as teacher in an elementary school, and to compete for that position in elementary subjects with men who knew little or nothing beyond those subjects.

Both these objections have been disposed of by the constitution of the Constructive Corps. For the future, while the apprentices in the dockyards will still retain the possibility of advancement to the highest posts, a new class is to be created, termed "Students of Naval Construction." Not more than three are to be entered annually by open competitive examination; they will receive special training at Portsmouth for six years in both professional and educational subjects, living meanwhile in quarters there, and receiving the same treatment as is given to the students in course of training as engineer officers of the Royal Navy. No possible objection need be felt by any gentleman in placing his son under these conditions, and the training is certain to be thorough. Once entered at the Training School, a student has a definite career before him, provided he is well behaved and diligent. He has simply to pass certain standards to insure entrance into the Naval College; and similar conditions hold good during his stay there, as well as at his graduation therefrom. Very properly, powerful inducements are offered to the students in order that they may exert themselves and pass out in the highest class; but those who pass the standard fixed are to receive appointments at once as Assistant Constructors in the Royal Navy. With position thus assured to begin with, and with duties to perform suited to the special training received, the graduates of the Naval College can look forward to an honourable and useful career in the Constructive Corps. Promotion throughout the subsequent stages is to be by selection, and not by competition, selection being governed by the reputations which men make in their professional work.

There are many degrees of rank in the new corps, reaching up from the junior assistant constructors, to constructors, chief constructors, and the highest office—that of Director of Naval Construction, now so worthily filled by Mr. Barnaby. But from the highest to the lowest all the members of the corps have recognised positions in due relation to one another. This is a great gain.

Still another notable feature in the new arrangements is the possibility which now exists for a naval architect who has obtained his training outside the Admiralty service to enter it after he has proved his capabilities for the appointment of assistant constructor by passing a test examination at the Royal Naval College. There are certain limits of age laid down, and it is possible that the number of candidates who will present themselves for some time to come will not be great. At the same time the Admiralty have shown a wise discretion in thus extending the field from which their shipbuilding officers may be recruited. The private trade has drawn largely hitherto from the Admiralty staff: perhaps some return will be made in future.

In the Constructive Corps are included all the principal officers at the Admiralty and in the Royal dockyards, and all the specially educated men from the Naval College who have been successful in their course of study. Provision is also made for admission to the corps of subordinate shipwright officers from the dockyards who may be qualified for the appointment. This is a matter of less public interest than those above mentioned, but it has a very important bearing on the discipline and smooth working of the dockyards.

These are the main features of the new arrangements. They promise well for the future. While retaining for the apprentice class their possibilities of advancement to the highest positions, the Admiralty have greatly enlarged the field of selection for their constructive staff, and made it possible for any gentleman to place his son in the Training School at Portsmouth with the assurance that the surroundings will be as suitable as the system of training is excellent. Further, the Admiralty have recognised the wisdom of training men who from the first shall take rank as officers, and not be compulsorily forced through the grade of workman in order to become officers. This is what is done in all the principal foreign navies and in private establishments: it need not involve any loss of practical knowledge of details, and it is a gain from an administrative point of view.

For my present purpose it will suffice to terminate here this sketch of a "new departure" which promises well for the Royal Navy, and to which most people will wish entire success. There are matters of detail which seem open to criticism, and it would be interesting, did space permit, to show in what respects the new regulations resemble or differ from the corresponding regulations in force in the French or other foreign navies. As this could not be done within the limits of this paper, I have been content to draw attention to the openings which the Admiralty have presented to youths who have a taste for naval architecture, but who would not submit to the drudgery of an ordinary apprenticeship; and have endeavoured to point out how the public service may be benefitted by the changes introduced.

The shipbuilding profession has hitherto been a very "close" one, both in the public service and outside it. But it may be reasonably anticipated that, at least in the Royal Navy and possibly in private establishments also, a change of system would prove advantageous. If the conditions for admission and training are made to resemble more closely those holding good in various branches of engineering, there seems no good reason why a larger number of well-educated and intelligent young men should not adopt naval architecture as a profession. The new Constructive Corps has been created on the recommendation of a departmental Committee, of which Sir Thomas Brassey was chairman. The Report of this Committee, as well as the minutes of the evidence taken by them, have been published as a Parliamentary Paper (No. 277 of 1883), and will well repay perusal. It may there be seen that the appointment of the Committee resulted chiefly from action taken by Admiral Sir Houston Stewart, when Controller of the Navy: and it is a matter of great gratification to myself that I had the honour of assisting that distinguished officer in the preparation of the scheme, which was substantially recommended by the Committee for adoption, and has been adopted by the Admiralty. A few years' experience will decide whether or not the benefits anticipated from the changes above described will be realised. Much must depend, no doubt, upon the manner in which the scheme is developed, and the pocess must be gradual and carefully watched if it is to be successful. But whatever the result may be, nothing but good can come from the changes which enlarge the field of selection for the shipbuilding officers of the Royal Navy, and which unite in one corps all ranks and classes of the constructive staff.

W. H. WHITE

THE FLORA OF PATAGONIA[1]

THIS work, the joint production of the late Prof. Lorentz and of Mr. G. Niederlein, is a substantial addition to our knowledge of the vegetation of one of the least explored portions of the earth. It forms one portion of the scientific results of the expedition into Patagonia conducted in 1879 by General Roca, who has since been elected President of the Argentine Confederation. The Indians who, under the vigorous and stern administration of General Rosas, had been terrified into inaction, if not into submission, gradually took courage when they had to deal with less energetic opponents. At repeated intervals the wandering tribes, especially those of Araucanian stock, made destructive incursions through North Patagonia and the south of the province of Buenos Ayres, massacring the white settlers and driving off the cattle. It had long been the declared policy of the Argentine Government to confine the Indians to the region south of the Rio Negro, by establishing military posts at suitable points in the valley of that river; and to carry out this project was the object of General Roca's expedition. The chief station occupied was Choloechel, a large island inclosed by two arms of the Rio Negro. From thence the upper valley of that river was followed to its junction with a large tributary, the Nauquem. Prof. Lorentz had already returned to Buenos Ayres, while Mr. Niederlein travelled northward to Mendoza. Although the expedition was carried out at an unfavourable season—the autumn and early winter of the southern hemisphere—the authors succeeded in collecting 337 species, of which thirteen are ferns and the remainder flowering plants, in a district which includes only the north-western portion of Patagonia. It is not, however, easy to say how many of the numerous species not hitherto recorded as natives of Patagonia are henceforward to be added to its scanty flora. Many of the species recorded were found in the region lying north of the Rio Colorado, which is generally regarded as the northern boundary of Patagonia, and are not said to spread to the south of that river. Again, as many as sixty-five species of flowering plants were collected in such an imperfect condition that the authors have not been able to assign to them specific names, and many of these will doubtless be found identical with those already known as natives of the country. Further, it must be added that, of twenty plants described as new species, several appear to rest upon slight distinctive characters, which, in the eyes of many experienced botanists, will entitle them to be counted rather as varieties than as altogether new species.

Making due allowance for these deductions, it appears that we may reckon about 150 species as additions to the meagre catalogue of the plants hitherto known as indigenous to Patagonia, scarcely 300 in number for a territory more than 1000 miles in length and from 200 to 400 in breadth. Apart from the interest felt by the systematic botanist in the special forms of vegetation displayed in each region of the earth, many questions of a more general character are suggested by the study of local floras, and that of Patagonia is especially suggestive. Ever since naturalists ceased to regard the existence of each organism as due to a special and separate act of creation, and have learned that the existing population of each region is derived by descent with modification from earlier races, the influence of geological and physical changes has assumed a paramount importance in regard to all changes relating to the geographical distribution of plants and animals. If we seek to understand how the flora of a given region of the earth has come to be what it is, our first business is to inquire into the past history of that region, and to ascertain from what sources the indigenous species may have been derived. With reference to the special features of the Patagonian flora, the subject was discussed during the past winter at a meeting of the Linnean Society. It was then pointed out that nearly the whole of Patagonia and a considerable part of the adjoining Argentine territory had been raised from beneath the sea-level during the latest geological period, and that the only quarters from which the vegetable population could be derived were either the range of the Andes or the subtropical region now included in the northern Argentine provinces. It was argued that the exceptional poverty of the Patagonian flora is not mainly due to climatal conditions, but to the fact that in the time which has elapsed since its upheaval only a relatively small proportion of the plants of the adjoining regions had been modified to suit the conditions of life in the newly-formed territory.

It is interesting to see what light is thrown on the subject by the present work, which, although bearing the date 1881, appears to have but very recently reached this country. Our previous knowledge of the flora was nearly confined to the region near the coast, whereas most of the plants here enumerated come from the territory near the eastern base of the Cordillera. Whether owing to the season, or to the fact that they do not extend to the interior, many of the indigenous species known to occur near the coast—at least a hundred might be enumerated—are absent from the enumeration of MM. Lorentz and Niederlein. But a comparison of all the materials accessible displays a remarkable degree of uniformity in the general features of the vegetation. When raised from the sea the newly-formed territory of Patagonia was dependent for a vegetable population on the immigrant species which it might receive either from the range of the Cordillera to the west, or from the subtropical region to the north. As a matter of fact the predominant features of the vegetation are derived from the lower zone of the Andes, the majority of the species being either the same or slightly modified forms of plants of that zone. Our knowledge of the eastern slopes of the Andes in Patagonia is so imperfect that we cannot say whether a few apparently very distinct plants, two of which are here described as types of new genera under the names *Niederleinia* and *Grisebachiella*, are derived from the higher zone of that range; but it is remarkable that as a general rule very few of the characteristic plants of the higher Andes should have been able to adapt themselves to the conditions of life on the plateaux of Patagonia.

The plants of the subtropical region have exhibited greater power of adaptation to new conditions. Of the larger trees none have been able to spread so far southward; and, except where planted and specially protected, it is not likely that they ever can do so. But of the small bushes and perennial herbs which make up the bulk of the flora a considerable number must be reckoned as more or less modified descendants of subtropical types. It is rather singular to note that this power of adaptation seems to be characteristic of certain groups or natural orders. The most marked instance is that of the *Leguminosæ*. In the Old World the tribes of this family characteristic of the tropics show no tendency to extend into the warm temperate zone, the only exceptions that suggest themselves to the writer being a few acacias in North Africa; whereas we find in this volume out of twenty-one species of indigenous Leguminosæ ten belonging to characteristic genera of the tropics, including two species of *Cæsalpinia* and one (new) species of *Mimosa*.

The condition of an extensive territory inhabited by a relatively small number of indigenous species, many of them probably but imperfectly adapted to their environment, was evidently very favourable for colonisation by new immigrants; and the chances in favour of the new comers were further increased on the introduction of agriculture and of domestic cattle from the Old World. The plough clears the ground from many bushes and

[1] "Informe Official de la Comision Cientifica agregada al Estado Mayor General de la Expedicion al Rio Negro (Patagonia) bajo las ordenes del General D. Julio A. Roca." Entrega II. Botanica. (Buenos Aires, 1881.)

perennial herbs, and cattle make war on the species suitable for their food, and at the same time carry with them the seeds of many species adapted to such means of transport. To these causes we must attribute the wide diffusion of many plants, chiefly from southern Europe, introduced by man, either accidentally or intentionally, into the Argentine region and North Patagonia. A few of these appear to have spread beyond the bounds of European colonisation, but the majority seem to keep pace with the extension of the white race and of domestic cattle.

This volume, dated 1881 when it went to press, but not published till 1882, is very well printed and illustrated by twelve well-executed lithograph plates, in a manner creditable to the typographic resources of Buenos Ayres, and reflects honour on the administration of the republic and on General Roca, who, as commander of the expedition, deserves the credit of associating with his staff several competent scientific men. We probably owe it mainly to his influence that the results have been given to the world in a manner so complete and satisfactory.

J. B.

ACROSS THE PAMPAS AND AMONG THE ANDES[1]

THE interest attaching to the confederation of South American provinces known as the Argentine Republic more than justifies Prof. R. Crawford in the publication of an account of his journeys across the Pampas and the Andes. Some fourteen years ago the Government of the Province of Buenos Ayres, foreseeing the vast importance of a line of railway which would connect the two oceans, entered into an agreement with the firm of Waring Brothers of London to send out a staff of engineers to explore and survey a route for a proposed Transandine railroad. Prof. R. Crawford was given the command, and, with his colleagues, left Liverpool in March 1871 for Monte Video, which was reached after a voyage of a month's duration. On landing, it was soon ascertained that matters were in desperate plight at Buenos Ayres. The frightful epidemic of yellow fever was still raging, the local Government had proclaimed public holidays and itself migrated to a distance from the doomed city, business of all sorts was suspended, and silence reigned in the streets. Under these circumstances, but for the pluck and energy of Prof. Crawford, the scheme for the survey across the Pampas would have come to an untimely end (that from the Chili side had commenced towards the end of April 1871); but he determined it should proceed, and never let the local authorities have any rest until all preliminaries were settled. In the meanwhile the enforced sojourn at Monte Video was not over pleasant. The city was in a state of siege, and it was not for some time after the arrival of the party that a temporary peace was patched up. Weary of the forced delay, Prof. Crawford and some members of his party visited Concordia and made a survey for the Salto Grande Canal. They passed, in their voyage up the Plate, Buenos Ayres, looking in the distance bright and pleasant, though death was stalking through it. In steaming up the Uruguay they saw Liebig's famed extract-of-beef factory at Fray Bentos, and McCall's vast establishment at Paysandu. In an account of a short excursion made from Concordia, we find the following interesting anecdote about the black vulture (*Cathartes atratus*) of La Plata; perhaps the coolness of the vulture's behaviour is fully equalled by the coolness of the driver in appropriating the stray horse:—

"The roads were very sandy, and the wheels sank deeply into them, making the carriage heavy to draw, so that the driver gladly appropriated a stray horse we met upon the way that seemed inclined to join himself to ours, and having extemporised a rude set of harness with some spare pieces carried in reserve, attached him to our team, and drove off in triumph with this new acquisition.

"I was sitting on the box-seat with my gun in hand, when a black vulture came flying past, at which I fired, bringing it to the ground with a broken wing. The strange horse testified his dissatisfaction with the proceeding by the most violent plunging and kicking, that required all the driver's skill and address to overcome.

"When at last he was brought to a state of rest, due, no doubt, in a great measure to exhaustion, the wounded bird occupied our attention by the strange coolness of its proceedings. Regardless alike of our presence and an injured wing, to say nothing of the noise and confusion the horse had created, instead of attempting to escape, it walked quietly up to us, as if about to demand an explanation of the treatment it had received; then mounting deliberately on the wheel of the carriage, hopped in through the open window as composedly as if it were a regular passenger about to occupy an inside seat for which it had been booked in the ordinary manner.

"So offensive was the odour emitted by the unwelcome intruder that we could with difficulty bring ourselves to approach and dislodge it; and when we had done this, the vulture took refuge under the legs of the strange horse, frightening him to such a degree that he began again his strenuous endeavours to get loose, not stopping till he succeeded in smashing the harness to pieces, and escaping from his flapping foe.

"I am afraid that I was not popular that afternoon with my comrades and the driver, for my unlucky shot had entailed upon them much inconvenience and delay, so that it was late when we reached the estancia house."

Just as the survey of the canal was finished, traffic between Monte Video and Buenos Ayres was resumed, and, returning to the former place, the whole expedition left for Buenos Ayres on June 16, 1871. The city was still overwhelmed with gloom. Between 20,000 and 30,000 of its inhabitants had been buried within the few previous months out of a population of only 200,000 souls. Numerous houses had the plague spot still marked upon them, but in a very short time things looked more cheerful, and there were no outward tokens of the plague the city had passed through. Now began the negotiations for the necessary escort to accompany the expedition across the Pampas. While the expenses of the expedition were in great measure to be defrayed by the local Government of Buenos Ayres, it will be remembered that this Government has no national authority, nor could it undertake any outside its own territory, it was therefore necessary for the provincial Government to come to an understanding, which they did, with the national Government and with its neighbouring provinces, and with the Republic of Chili, for the passage of the expedition through these lands and for the supply of a military escort. "Along the whole route," the general commanding on the frontier reports to the President of the Republic (May 20, 1871), "there will be danger: the Indians were in a state of alarm that the objects of the Survey were to take more and more of their territories from them, and were determined to destroy the members of the expedition when possible," and the general calculated that an adequate force to properly protect the party from all danger should not number less than 1500 men perfectly equipped. Under these circumstances, and after some months' delay, the originally proposed route was abandoned, and a more northern one, in territory likely to be more free from the predatory attacks of the Indians, was adopted, and with a small escort the expedition left Buenos Ayres on August 17, 1871, and took up their quarters at Chivilcoy, 100 miles to the west of it; here final preparations were made for the formidable journey across the Pampas. The Chili expedition in the meantime had, before reaching the summit of the mountains,

[1] "Across the Pampas and the Andes." By Robert Crawford, M.A. With a Map and Illustrations. (London: Longmans, Green and Co., 1884.)

been obliged, owing to heavy falls of snow, to abandon the work, which was not resumed until September. In this month too the preliminary party of the Pampas expedition started, and were followed by the rest of the party towards the end of October. We leave the reader to peruse in the volume itself an account of all the troubles and difficulties that had to be, and were, overcome ere a party of sixty-six persons, not counting the escort, could be started on such a journey across the boundless Pampas.

By the end of November the Indian frontier was reached, the work of the Survey having proceeded well. Water was often scarce, and only procured by sinking wells, which furnished but very moderate supplies. Some very sudden changes of temperature were encountered. Thus, on November 13, "the thermometer, which had hitherto been registering great heats, suddenly fell to 26° F., converting the water in our tents into ice." Deer (*Cervus campestris*) and partridge (*Nothura maculosa* and *Rhyncotus rufescens*) were abundant. The deer at the season they were met with went about in small herds of from three to seven. As they advanced water became more scarce, and moreover was often muddy. Once when the stock at the disposal of the engineers' mess was reduced to a small kettle-full, and that heavily charged with sediment, it was resolved as a means both of economising the fluid and making the most of the mud, that it should be made into coffee. Anxiously the little group sat around the camp fire watching the kettle, the water in which was never to boil, for by some unfortunate accident, the particulars of which were never explained, as the subject was one too painful to be talked over, the kettle was overset, and its contents poured out on the resenting flames, amidst a groan of horror from the parched throats around it. In this Indian territory Rheas (*Struthio rhea*) were numerous, and the young birds were very easily tamed, those captured by the men becoming pets in a few days, and wandering about the camp like young turkeys. The generally careful and prudent engineer-in-chief was here on one occasion so heedless of his own safety that he was nearly coming to grief. One night he passed out of bounds unnoticed, but on attempting to regain the encampment he found his situation most serious, for he was at once challenged by the sentry, who happened to be a Frenchman fresh from the experiences of the Franco-German war, and not being satisfied with Prof. Crawford's explanation, he proceeded to present his rifle. Not anxious to serve as a target, the professor, to prevent the sentry from getting him projected on the sky line, fell flat on the ground, and while in that somewhat undignified position, some of the men coming out on hearing the alarm, recognised his voice, and released him, resolving to be more prudent the next time that he wandered beyond range. Several troops of wild horses were met with; they had all flowing manes, and tails that swept the ground. On November 29, an attack in force of the Indians being most imminent, and the military escort being ordered to retire on Fort Media Luna, the surveying operations were most reluctantly discontinued. The last peg was driven well into the ground and covered with a large mound of earth. When thinking of resuming operations, Prof. Crawford demanded an escort of 200 men, but after a promise of fifty, was only eventually furnished with twenty. To continue the survey work with such an escort was quite out of all reason, and the question arose, what was to be done? After all that had been endured and all that had been accomplished, was the expedition to be abandoned? Such a termination would have been a most painful one to all engaged; Crawford therefore determined to risk everything, and endeavour to accomplish the mission by crossing the Pampas in a compact body, keeping along the line of frontier until the Andes were approached, and then bearing southwards, to ascend their eastern slopes until they should join their colleagues from the Chilian side at the place of rendezvous. This determination they proceeded to carry out on December 6, when Media Luna was left. On the 18th the swampy district known as the "Amarga" was reached

Tupungato, from the River Lujan.

Here the Rio Quinto loses itself in an extensive sandy plain to reappear not far off as the Salado, which river falls into the Plate, about sixty miles south of Buenos Ayres. A couple of days later, near Fort "Nichochæa" the cactus was met with and the potato in blossom. The tubers of the latter were very small, and, when boiled, tasteless. Lakes were now often met with, the water generally sweet, and the lakes encircled by sand-hills. At Fort Sarmiento the Rio Quinto was crossed; it had here cut for itself a channel 300 feet wide through a gravelly soil to a depth of some ten feet below its banks. About December 23 trees became numerous, and the monotony of the ocean-like plain was broken by the appearance of a mountain (El Morro). Here Colonel Roca was in command of a garrison, and at once struck Prof. Crawford as a man most highly gifted by the possession of many qualities not often associated in the same individual. He has since risen in his profession to be a general, and now as President of the Argentine Republic directs its affairs with wisdom and firmness.

The country now became more interesting, and the Rio Quinto presented well-wooded banks. Christmas Day was spent in camp, the thermometer indicating 104° F. in the shade. At Villa Mercedes the Rio Quinto runs in a valley it has formed for itself some 1270 yards wide. Here oxen were changed for mules, and the weariness of the delay at this station was aggravated by the great heat of the weather during the day, and the intensity, by contrast, of the cold at night, the thermometer ranging from 107° F. in the shade during the day to 34° F. at night. The mules gave great trouble, refusing to carry the baggage carts, and almost bringing the expedition to a close; but again the energy of its head succeeded in getting matters to rights, but not before a journey to San Luis, and procuring there the requisite number of pack mules. San Luis was left on February 3, and Mendoza was reached about the 11th. The first sight of the glorious range of the Andes inspired the expedition with a fresh energy.

"The scene which met our tired eyes was one of such magnificence and grandeur as soon dispelled all weariness, and filled us with wonder and amazement. There stood the Andes boldly outlined against the sky, with the mighty 'Tupungato' towering like a giant above the other peaks, its snow-clad summit bathed in gold by the sun's first rays (itself not yet apparent over the horizon), while rosy clouds alternating with crimson and violet of deepest hue, brought out the lights and shades upon the rugged mountain tops, and all below was merged in one vast sea of sombre grey, night's mantle, which the sleeping earth had not yet put aside. Each moment did the picture alter, and every change brought with it some fresh beauty not before perceived, till the sun, rising from the pampas as from the ocean, covered the mountains with a dazzling light, in which the delicate tints and shades of colour disappeared, and last of all the darkness at their base resolved itself into a thin blue cloud like smoke, which hung about them for a while, and then too, was in turn forced to yield and vanish as the rest had done. It was impossible to look on such a scene unmoved, or to find words wherewith to reproduce it to another's eye. Gladly would we have lingered gazing at the view before us, but business, demanding our attention, recalled us to more practical affairs. It was necessary that we should be off without delay; a long and weary journey lying before us. That day we travelled six-and-thirty miles, three-fourths of the distance being over a barren sandy soil, destitute alike of grass and water. The day was very hot, and during it all our dogs, which for many months had followed the fortunes of the expedition, disappeared; where they had gone to no one knew, but it was thought that possibly they had sought shelter from the scorching heat under some thick shrubs we passed upon the route, and never afterwards had been able to overtake or find us; or when the cold of night came on, they may have retraced their steps back on the route we took that morning and joined their lot with the first settler they fell in with. Whatever was their fate, we deeply regretted to have lost our faithful followers and friends."

Soon they were up among the Andes into deep ravines among lofty hills, now descending into valleys, and soon afterwards ascending giddy heights. An extinct volcano, now a beautiful mountain called the "Cerrito Diamante," was passed; some thirty miles from it a rill of a yellowish-white fluid, like petroleum, issuing from the mountain-side at a considerable height, was discovered. The source from which it flowed was at the junction where a hard metamorphic rock interspersed with small augite crystals overlay a stratum of volcanic tuff. It was in form like a crater of a volcano, and full of a black bituminous matter, hot and sticky, which could be stirred to a depth of about 18 inches. Floundering in it was a polecat, which had been enticed to its fate by a bird caught in this natural birdlime. The overflow was 2 or 3 feet wide, and as it spread out it became of an asphalt-like form. Two other little birds were found entangled in the stream, and on being released both feathers and skin came off. Possibly they had mistaken the stream for water. A further search revealed many bird and small mammalian skeletons embedded in the mass, possibly a puzzle for some palæontologist in days to come. After leaving the River Atuel sandstone and limestone strata were met with, and on February 29 their colleagues from the Pacific coast who had crossed the Andes by the Planchon Pass were met. The combined party rested a few days in the highland valley of Las Leñas Amarillas, where guanacos abounded. The watershed of this district was reached at a level of 9200 feet above the sea, the scenery being of surpassing beauty, and the Andes are described as having no lovelier spot than this secluded "Valle Hermoso." Here a good deal of land-surveying was accomplished, and also in the region of the Rio Grande. In the middle of March the passage of the Andes was begun *viâ* the Planchon Pass. The attempt to cross by the head of the Rio Grande was frustrated by the dangerous illness of a colleague when a height of about 11,000 feet had been attained, and fearing the consequences if they bore him to the summit (1000 feet higher), they retraced their steps and went over by the Planchon Pass, 8225 feet above sea-level. On the descent silver and copper mines were passed. After five months of hardships, a day at the lovely baths of Cauquenes was thoroughly enjoyed, and on March 25 the party arrived at Santiago de Chili, described as a city which for its position cannot be surpassed in grandeur and the magnificence of its surroundings. After a fortnight's sojourn here, Valparaiso was reached by rail, from whence, proceeding through the Magellan Straits, Monte Video was reached, and thence home.

All through the narrative the reader's interest is sustained, and the author might often indeed have ventured on further details without the least risk of being tedious. The trials and hardships undergone are very slightly dwelt upon, but they must have been many and great. On the result of his labours, and on this pleasant narration of some of the chief incidents of his travels, we heartily congratulate Mr. Crawford, whom we are also glad to find once more located within the walls of his ancient University, laying the varied experiences of his life before the engineering classes of Trinity College, Dublin.

In a most valuable and important series of appendixes we have an excellent account of the peaks and passes of the Andes, which seem in every way worthy of the Alpine clubs of Europe; a most important essay on the Argentine Republic, its position and extent, its Indian frontier and invasions, its colonies and railways—a Republic with a great future before it, and one in which our British interests are largely involved.

THE INTERNATIONAL HEALTH AND EDUCATION EXHIBITION

THERE is at first sight some lack of unity of purpose in an exhibition which undertakes to illustrate such diverse subjects as health and public education. This impression will be in the present case confirmed partly by the postponement of the opening of the Educational Section to the month of June, and partly by the fact that the display of educational appliances will be held in the neighbouring building, the new Technical School of the City and Guilds of London Institute, and not in the galleries of the Exhibition building itself. A mere miscellaneous collection of objects more or less illustrative of school work, *e.g.* furniture, fittings, apparatus, and diagrams, would, however, prove of little general interest and value, unless it were on a very comprehensive scale. The Executive Committee, therefore, have wisely decided to limit the scope of the educational part of the Exhibition of the present year, and to direct the attention of exhibitors mainly to the elucidation of a few special problems which possess exceptional importance or public interest at the present time. Foremost among these are the subjects of technical and scientific instruction, trade and apprenticeship schools, the teaching of art, and the Kindergarten with other devices for infant training. The accidental association of this part of the Exhibition with one devoted to the subject of health has also naturally suggested another class of illustrative display likely to prove particularly interesting to school managers and the public at this moment. While the Executive Committee has shown no disposition to encourage the absurdly exaggerated and not very sincere outcry which has been raised about the "over-pressure" of children in schools, they have shown much judgment in giving special prominence to those "exhibits" which are designed to illustrate the conditions of healthy life in schools. Accordingly, models of the best school buildings, appliances for warming, lighting, and ventilating, improved desks and fittings, contrivances for securing right posture for the limbs and for preventing injury to eyesight, precautions against disease in schools, will be largely shown. The whole subject of physical training will also, it is expected, be illustrated with unusual fullness and variety. Models and examples of the latest and best forms of gymnastic apparatus in use in England and in foreign countries will be shown; and arrangements are being made, with the sanction of the heads of the Admiralty and of the War Office, for the practical exposition of the methods of military drill in use in the great military and naval schools at Chelsea and Greenwich, on certain afternoons on which the boys can be spared for this purpose from their ordinary school duties.

The increased attention now being directed to the whole subject of infant training; the extended interest taken by the best teachers in the study of the methods of Fröbel; and the recognition by the Education Department for the first time, in Mr. Mundella's Code, of the need of training, object lessons, recreation, and varied employment in infant schools, as well as instruction in reading, writing, and arithmetic, have justified the appropriation of a considerable space to the Kindergarten, and to the exhibition of pictures, games, manual exercises, and apparatus specially adapted for the training of very young children, whether in schools or nurseries. There is reason to believe that this department of the display will be especially full and interesting, and will comprise some of the latest and most ingenious of the devices for infant discipline which are in use in Germany and Switzerland, as well as in our own country.

Closely connected also with the general design of the Exhibition to show how school-life may be made healthier, brighter, happier, and more interesting, there will be a considerable display of pictures and school decorations. The "Art for Schools Association" and other exhibitors will seek to show how the school-room may be incidentally useful in improving the taste and stimulating the imagination of the scholars; and it may be hoped that many teachers will gather from the Exhibition some fruitful suggestions as to the manner in which art may give added reality and force to lessons on history, on descriptive geography, on the facts of science, and on the life of the ancient world.

The London, Birmingham, and other School Boards have arranged for collective displays of their best fittings, desks, and other apparatus. Illustrations and models of school kitchens, cookery schools, and the latest appliances for the practical teaching of domestic economy will be tolerably numerous; and special pains have been taken by those members of the Education Committee who have recently served on the Technical Instruction Commission to procure some of the most characteristic illustrations of the methods of technical and industrial teaching in use in the trade and apprentice schools of the Continent.

There will be a library and reading room attached to the educational department of the Exhibition; and a large collection of the newest text-books, treatises, diagrams, and works of reference having relation to the subject of the Exhibition will be so arranged that they may easily be consulted by visitors.

One very interesting feature of the whole programme will be found in the plan—not yet fully matured—for an International Congress or series of Conferences to be held in connection with the Exhibition during the first week in August. A large attendance of delegates from foreign countries is expected, and some of the most important educational problems of the day will be discussed. The sub-Committee, which has spent much time in arranging the details, is representative in its character, and consists of Lord Reay, the Hon. L. Stanley, two of the Senior Inspectors of Schools, Mr. Sharpe and Mr. J. G. Fitch, Archdeacon Emery, the Rev. Dr. Graham of the Hammersmith Training College, Mr. Storr, Mr. Magnus, Mr. St. John Ackers, and Dr. Rigg. So far as the arrangements have yet been published, they promise to provide a series of valuable public discussions, by persons of authority in their special departments, on the organisation of primary, secondary, and university education; on the conditions of health and physical development in schools; on the professional training of teachers, the testing of their qualifications, and the public recognition of those qualifications; on several special departments of instruction, *e.g.* infant training, art teaching, science and technical teaching; and on museums, libraries, and other subsidiary agencies by which the influence of the school may be extended to the home life, to leisure, and to the means of self-improvement.

NOTES

THE Council of the Royal Society have selected the following fifteen candidates to be recommended for election at the annual meeting on June 12 next:—Prof. George Johnston Allman, LL.D., Prof. Isaac Bayley Balfour, D.Sc., Joseph Baxendell, F.R.A.S., James Bell, F.I.C., Prof. Walter Noel Hartley, F.R.S.E., Prof. Alexander Stewart Herschel, M.A., Wilfrid H. Hudleston, M.A., Prof. Horace Lamb, M.A., Prof. John G. McKendrick, M.D., Arthur Ransome, M.D., Prof. Charles Smart Roy, M.D., Prof. Arthur William Rücker, M.A., Joseph John Thomson, B.A., Lieut.-Col. Charles Warren, C.M.G., and Prof. Morrison Watson, M.D.

THE following three *savants* were elected Foreign Members of the Linnean Society at the last meeting, May 1:—Dr. Ernst Haeckel, Professor of Zoology and Director of the Zoological Institut, Museum, University of Jena, among other things well known for his studies of Sponges, Radiolarians, Medusæ, &c.;

Dr. Alexander Kowalevsky, Professor and Director of the Zootomical Cabinet, &c., in the University of Odessa, notable for his anatomical and embryological researches on the Tunicates, Holothurians, Cœlenterata, &c.; and Dr. S. Schwendener, Professor of Botany, University of Berlin, whose labours in cryptogamic botany, more especially Lichens and Algæ, receive due appreciation by his kindred workers on these and allied topics.

A CIRCULAR signed by Prof. Ray Lankester, Secretary *pro tem.*, and Mr. Frank Crisp, Treasurer *pro tem.*, has been issued from Burlington House, London, with reference to the proposed "Marine Biological Association of the United Kingdom." The object of the Society, as explained by the speeches made at the meeting of March 31, is to erect and maintain at suitable points on the coast one or more laboratories similar to the Zoological Station of Naples and the American Laboratories of Newport and Chesapeake, to which naturalists may resort for the purpose of investigating the history of marine life, both animal and vegetable, and the various conditions affecting the welfare of British food-fishes and mollusks. It is proposed, in the first place, to establish a laboratory on the south coast of England. To build this laboratory and equip it in an efficient manner with boats, dredging apparatus, and tanks, a sum of not less than 10,000*l*. is desirable, whilst an income of not less than 1500*l*. a year will be required to maintain it and to pay the wages of attendants and fishermen and the salary of a resident superintendent. The Provisional Committee, as authorised by the meeting on March 31, has made the following rules with regard to membership of the Society:—"The Members of the Society shall consist of three classes—(*a*) Donors of 500*l*. and upwards to the Society, who shall be Governors and permanent Members of the Council. (*b*) Donors of 100*l*. to the Society, who shall be Founders and Members of the Society for life. (*c*) Annual Subscribers of 1*l*. 1*s*. The subscription may be compounded for at any time by a payment of 15*l*. 15*s*." The members of the Society will shortly meet to elect a Council and Officers, and to adopt a constitution and rules. It is proposed that the members shall meet at least once a year for the purpose of electing a Council and transacting other business, and they will receive reports of the work done by the Society, and especially of the investigations carried out in the laboratory maintained by its agency. In addition to the fixed contributions above mentioned in connection with membership, the Committee invite special donations towards defraying the expenses of erecting the first laboratory. Those desiring to become members should communicate as soon as possible with the Treasurer, at 6, Old Jewry, E.C.

THE Annual Meeting of the Academy of Sciences of Paris was held on Monday, M. Blanchard, president for 1883, being in the chair. M. Blanchard opened the sitting by an address, reciting all the losses that the Academy had sustained during the past year. He dwelt principally on the exceptional eminence of M. Dumas. He summarised also the several scientific expeditions which had been fitted out by the French Government during the year after having taken the advice of the French Academy. M. Bouley read the list of the awards granted by the several academical commissions, and which is too long to be reproduced in our columns, the number of these foundations being yearly enlarged; thus far no less than three prizes were distributed for the first time—the Penaud Prize for progress in Aëronautics to MM. Tissandier, Taton, and Leroy de Brognac, and two prizes by Le Petit d'Ormay, one for physical sciences, and the other for mathematics. The interest of the Bréant Prize (4000*l*.) for curing the cholera was bestowed on M. Pasteur's pupils, who have studied the subject in Egypt on the spot. One of the astronomical prizes was given to M. Stephan of Marseilles, and the other to several members of the transit missions not belonging to the Academy Gold medals were distributed to the marine officers who took part in the expedition of the *Travailleur* under Milne-Edwards for exploring the Atlantic, and to those who wintered with the *Romanche* in Terra del Fuego, in connection with other Polar expeditions. M. Bertrand read the *éloge* which had been written by M. Dumas on the brothers Deville, both of them members of the Academy of Sciences, who died, Charles, the geologist, in 1876, and Henry in 1881, both at the same age. After having read this address on behalf of his illustrious colleague, M. Bertrand read for himself an *éloge* on Puiseux, a Member of the Mathematical Section.

THE following, according to *Science*, is a complete list of the papers read at the meeting of the United States National Academy of Sciences, April 15 to 18:—G. K. Gilbert, the sufficiency of terrestrial rotation to deflect river-courses; T. Sterry Hunt, the origin of crystalline rocks; Simon Newcomb, on the photographs of the transit of Venus taken at the Lick Observatory; A. E. Verrill, zoological results of the deep-sea dredging expedition of the U.S. Fish Commission steamer *Albatross*; Ira Remsen, the quantitative estimation of carbon in ordinary phosphorus; reduction of halogen derivatives of carbon compounds; Elias Loomis, reduction of barometric observations to sea-level; C. S. Peirce, the study of comparative biography; C. S. Peirce and J. Jastrow (by invitation), whether there is a minimum perceptible difference of sensation; S. P. Langley, the character of the heat radiated from the soil; J. E. Hilgard, on the depth of the western part of the Atlantic Ocean and Gulf of Mexico, with an exhibition of a relief model; on the relative levels of the western part of the Atlantic Ocean and Gulf of Mexico with respect to the Gulf Stream; account of some recent pendulum experiments in different parts of the world, made in connection with the U.S. Coast and Geodetic Survey; E. D. Cope, on the structure and affinities of Didymodus, a still living genus of sharks of the Carboniferous period; on the North American species of mastodon; Theo. Gill and John A. Ryder (by invitation), the characteristics of the lyomerous fishes; on the classification of the apodal fishes; Theo. Gill, on the ichthyological peculiarities of the bassalian realm; George F. Barker, on the Fritts selenium cell; on a lantern voltmeter; George J. Brush, on the occurrence of mercury in native silver from Lake Superior; H. A. Rowland, progress in making a new photograph of the spectrum; B. Silliman, on the existence of tin ore in the older rocks of the Blue Ridge; H. M. Paul (by invitation), the Krakatoa atmospheric waves, and the question of a connection between barometric pressure and atmospheric electricity; John S. Billings, memorandum on composite photographs in craniology; A. W. Wright, some experiments upon the spectra of oxygen; Elliott Coues, on the application of trinomial nomenclature to zoology; E. M. Gallaudet (by invitation), some recent results of the oral and aural teaching of the deaf, under the combined system; F. W. Clarke (by invitation), jade implements from Alaska; Henry L. Abbot, recent progress in electrical fuses; J. S. Diller (by invitation), the volcanic sand which fell at Unalashka, October 20, 1883, and some considerations concerning its composition. The following biographical notices of deceased members were also read:—Of Gen. G. K. Warren, by H. L. Abbot; of Prof. Stephen Alexander, by C. A. Young; of Dr. J. Lawrence Smith, by B. Silliman; and of Dr. John L. LeConte, by S. H. Scudder.

ON Saturday last a banquet was given by a number of anthropologists to M. Gabriel de Mortillet, Conservator of the St. Germain Museum of National Antiquities, and his portrait, was presented to him. M. de Mortillet stated that his usual summer excursion would take place this month or in the beginning of June, and that Brittany would be chosen as a field for exploration. Any person wishing to join the Professor

in his scientific tour may write to M. de Mortillet at the Château de Saint Germain. The banquet hall was decorated with a life-size picture of an early Gaul. The picture was executed according to the last discoveries of M. de Mortillet. The man is represented as having no hair on his body; his arms are very long and muscles very powerful, but the toes of his feet are not opposable, although they could be used for climbing the trees of the primitive forest. His jaw is strongly prognathous, but not at all equal to that of an anthropoid ape. His breadth is strongly compressed laterally and his abdomen prominent. The skin is not negroid, but of our present colour. The expression of the face is in intelligence on a level with that of an Australian.

ANTHROPOLOGY plays a great part in the Paris *salon* this year. One of the largest pictures, attracting the attention of crowds, represents a primæval tribe preparing in their cave to feed upon an *Ursus speleucus* which has been killed by the warriors with their stone implements.

THE spring meeting of the Institution of Mechanical Engineers was held at the Institution of Civil Engineers on May 1 and 2. The most interesting paper read was on the Consumption of Fuel in Locomotives, by M. Georges Marié, Engineer to the Paris and Lyons Railways. This paper is of considerable importance as bearing on the actual economy of the locomotive considered as a heat engine. The chief conclusion is that the locomotive is a better engine, as regards economy of fuel, than is usually believed, and cannot be very much improved unless the pressure in the boiler can be increased at one end or a condenser applied at the other. The author looks forward confidently to both these improvements, but when achieved they will, he considers, necessitate an improvement in the valve gear, and probably the use of compound engines on the scheme now brought forward by Mr. Webb. With these and with some other improvements, such as a better clothing of the boiler and the heating of the feed-water by the exhaust-steam, M. Marié looks forward to the locomotive attaining a position, as regards economy of fuel, much beyond even that which it possesses at present. The other papers read were entirely of a practical character, with the exception of one by Mr. Robert Gordon, of Burmah, describing the apparatus used at Mr. Froude's works at Torquay, for testing current meters. The arrangement of the tank, dynamometer, governor, &c., is clearly described, but would hardly be intelligible without the aid of drawings.

WE are glad to direct the attention of our readers to the *Health Journal*, published by Heywood of Manchester, and which, with the May number, has concluded its first volume. The *Journal* is a monthly review "of sanitary science and of voluntary effort for the public good." It seems to us to be admirably calculated to serve the purpose for which it has been established, and we hope it will receive all the encouragement it deserves.

THE recent threat of certain French journals that their troops would occupy the island of Hainan until China had paid an indemnity has directed attention to that little-known appendage of the Chinese Empire. In a late number of that valuable periodical, the *China Review*, we find an account of a journey through Hainan by Mr. Henry. As in other outlying possessions of China, the native tribes have succeeded in a measure in holding their own against the ubiquitous Chinese. The northern part of the island is described as a large plain, while the central and southern portions are mountainous. Here the aboriginal tribes, the Les, take refuge. They are cordial and hospitable to strangers, and are probably of Malay origin. There are fifteen or sixteen different tribes, known under distinct names, varying more or less in dress, language, and customs, but all evidently belonging to one homogeneous race, bound together by common ties, and, as a rule, living on friendly terms with each other. The flora and fauna appear singularly rich, and but little investigated. In a visit of a few weeks the late Mr. Swinhoe noted 172 species of birds, nineteen of which were new to science, and were first described by him. The leeches are an especial plague to the traveller. They are described as of a grayish-brown and earthen hue, and vary from half an inch to an inch and a half in length, and swarm from the ground on all sides. Along the path, on the ends of grass blades and branches of shrubs, they may be seen holding by one end, while they reach out their whole length feeling on every side for their prey. The instant they touch foot or hand, or any part of the body, they take fast hold, and can only be detached by the application of fire, or when they are sated with blood. The natives carry bamboo sticks, with which by a quick motion they can sometimes detach them. Although the people appear in a state of rural prosperity, as there is very little foreign trade, while the climate is bad, it is difficult to see what France would gain by the occupation of the island.

REPORTS from Mount Hamilton, California, *Science* states, say that this has been the most stormy winter known since observations were begun at the Lick Observatory. The bad weather did not begin till so late in January that a drought in California was feared; but there have been 40 inches of rain and melted snow up to April 4, and at that date the mountain was covered with 2 feet of snow. The anemometer cups were blown away, with the wind-gauge indicating 65 miles per hour. The lowest temperature has been + 12°; and at this temperature outside water did not freeze within the uncompleted buildings.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus* ♀) from India, presented by Miss Harbord; a Pig-tailed Monkey (*Macacus nemestrinus*) from Java, presented by Miss Ethel Fenwick; a Macaque Monkey (*Macacus cynomolgus* ♂) from India, presented by Mr. F. Harrison; a Garnett's Galago (*Galago garnetti* ♂) from Eastern Africa, presented by Lieut. James Knowles, R.N.; a Dow's Tapir (*Tapirus dowii* ♂) from Venezuela, presented by Mr. Reginald Pringle; a Spotted Ichneumon (*Herpestes nepalensis*) from Nepal, presented by Mr. John Walker; two Clapperton's Francolins (*Francolinus clappertoni*) from West Africa, presented by Major H. Wade Dalton; two Chukar Partridges (*Caccabis chukar*) from North-West India, presented by Lieut.-Col. C. Swinhoe; a Herring Gull (*Larus argentatus*), European, presented by Miss Laura Dunnage; two Barn Owls (*Strix flammea*), British, presented by Mr. R. Church; two Hoary Snakes (*Coronella cana*) from South Africa, presented by Mr. E. Watson; two Wattled Cranes (*Grus carunculata*) from South Africa, two Spur-winged Geese (*Plectropterus gambensis*), four Vinaceous Turtle Doves (*Turtur vinaceus*), three Harlequin Quails (*Coturnix histrionica* ♂ ♂ ♀) from West Africa, deposited; a Grey-cheeked Mangabey (*Cercocebus albigena* ♂) from West Africa, two White Cranes (*Grus leucogeranos*) from India, a Cabot's Horned Tragopan (*Ceriornis caboti* ♂) from China, a Banded Gymnogene (*Polyboroides typicus*) from Africa, two Yucatan Blue Jays (*Cyanocitta yucatanica*) from Yucatan, two Axolotls (*Siredon mexicanus*) from Mexico, purchased; a Moustache Monkey (*Cercopithecus cephus*) from West Africa, received in exchange; a Maholi Galago (*Galago maholi*), seven Coypus (*Myopotamus coypus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

WHITE SPOTS UPON VENUS.—Four years since M. Trouvelot drew attention to two remarkable white spots which he had observed on opposite limbs of Venus, near the extremity of the cusps, from November 13, 1877, to February 7, 1878. The

southern spot was the brighter of the two, and "appeared then to be composed of a multitude of bright peaks, forming on its northern border a row of brilliant, star-like dots of light." The white spots disappeared after the inferior conjunction, which occurred on February 21.

At the sitting of the Academy of Sciences of Paris on March 24, M. Trouvelot mentioned that on two hundred and forty-two occasions since February 1878 he had observed one or other of the luminous spots, and occasionally both, and had made upwards of one hundred and twenty drawings. Since April 5 in the present year he had not lost sight of the northern spot, which alone was visible at that date. He did not find the spots affected by the diurnal rotation of the planet, and hence infers that the axis passes either through or very close to their centre. In this view it will be interesting to compare the position of the axis of the spots determined by his observations with the results obtained by De Vico and others. An attempt in this direction, founded upon some of the more satisfactory drawings, did not promise a near agreement. M. Trouvelot adds that the spots appear almost permanent, and thinks they are the summits of high mountains projecting beyond the cloudy envelope, generally opaque, which covers the planet.

The observations in 1877-78 were made at Cambridge, U.S., those of the present year at the Observatory of Meudon. De Vico's investigation on the position of the axis of Venus appeared in the *Memoirs* of the Observatory of the Collegio Romano for 1840-1841: it can hardly be said that his results, founded upon data necessarily vague, have inspired much confidence amongst astronomers. He made the inclination of the equator of Venus to the ecliptic 53° 11′, and the longitude of the ascending node 57° 19′ for 1841; the rotation of Venus in sidereal time, 23h. 21m. 21·93s.: these are the figures quoted in Secchi's "Life of De Vico."

THE GREAT COMET OF 1882.—Prof. Howe notifies that he has undertaken a definite determination of the orbit of this comet, which will doubtless be a work of some labour. Thus far calculation appears to indicate that the comet was moving in an ellipse, with a period not differing much from eight centuries: Kreutz gave 843, Fabritius 823, Frisby 794, and Morrison 712 years; the orbit of Fabritius depends upon the widest extent of observation. Between the earliest and latest accurate positions the comet described an orbital arc of 340°: a similar arc was traversed by the comet of 1680 between its discovery by Kirch on the morning of November 14 and the last observation by Sir Isaac Newton on March 19 following.

Those who may have unpublished observations of position of the great comet of 1882 will do well to communicate them to Prof. Howe forthwith.

BRORSEN'S COMET OF SHORT PERIOD.—We have not yet met with any intimation that an ephemeris of this comet for the approaching reappearance is being prepared: that for the last return in 1879 was furnished by Prof. L. R. Schulze of Dobeln; the time of perihelion passage was about eleven hours later than his calculation gave it. Disregarding perturbation, the comet would be again due at perihelion in the middle of September next, in which case it would be observable in the two hours before sunrise, in August and September, under somewhat similar conditions to those in 1873. Supposing the perihelion passage to occur September 14·5, the comet's position at that time would be in about R.A. 154°·5 and N.P.D. 76°·2, the distance from the earth 1·41.

Since the discovery of this comet within one day of perihelion passage in 1846 it has been observed at four returns, viz. in 1857, 1868, 1873, and 1879.

THE IRON AND STEEL INSTITUTE

THE annual meeting of the Iron and Steel Institute took place at the Institution of Civil Engineers on April 30 and May 1 and 2. The proceedings commenced with the reading of the Council's Report and the Accountant's statement, and with the presentation of the Bessemer Medal jointly to Mr. E. B. Martin of Dowlais and Mr. E. Windsor Richards of Middlesbrough, in recognition of the part taken by them in introducing the basic process for the manufacture of steel. In returning thanks, Mr. E. Windsor Richards mentioned that his firm, that of Messrs. Bolckow, Vaughan, and Co., were now making no less than 3000 tons per week by this process from Cleveland pig-iron, such as would have been thought, until recently, wholly unsuitable for steel-making. Sir H. Bessemer, who was present, congratulated the recipients and the steel trade generally upon the brilliant success of Messrs. Thomas and Gilchrist's invention.

The first paper read was by Mr. I. L. Bell, F.R.S., and dealt with the use of Raw Coal in the Blast Furnace. It pointed out that this question, as being more complicated than that of coke, had never been treated before the Institute, although raw coal was largely used in the United States in the form of anthracite, and in Scotland in the form of the splint coal of the Lanarkshire coal-field. It is with the latter that the paper was chiefly concerned. Taking the Brockwell seam as a good specimen of Durham coking coal, analyses were given of it first in its raw state, and secondly when converted into coke, together with the number of heat-units developed from one weight-unit of each. It appears that this number is 7437 in the case of the coal, and 7395 in the case of the coke, so that the heat developed in the two kinds of fuel is practically the same. This theoretical result was checked by experiments on a large scale made upon the North-Eastern Railway, using the same engines and the same weight of trains. The trials were continued for one week with each kind of fuel, full loads being taken to the place of shipment and the waggons returned empty to the collieries. The result in one trial in pounds consumed per train mile was 40·5 of coal and 41·6 of coke. In another experiment the difference was larger, but still it was not serious, and the theoretical deduction just given is thus fully confirmed. This equality of value between coal and coke is not, however, found to exist in the blast furnace, for the simple reason that the volatile constituents of the coal are scarcely oxidised at all, and therefore give but very little useful effect. They might, however, be utilised in another way, namely, as a means of reducing the oxide of iron to the metallic state. The gas from the coal would thus do part of the work now done by CO, and might enable a larger quantity of CO_2 to be evolved in the escaping gases. At present, however, this effect does not seem to be realised in practice. Analyses were given of the Lanarkshire splint coal, which show that, as a source of heat, it is inferior by about 30 per cent. to the South Durham coal. Analyses were also given of the escaping gases where this coal is used for smelting, and from this the quantity of heat evolved and appropriated was calculated, and compared with furnaces using coke. It thus appears that the raw coal occasions a much less perfect oxidation of the carbon, and in consequence a much smaller evolution of heat. On the other hand, the hydrogen contained in the coal affords a large supply of heat, but this and far more is absorbed in the expulsion of the volatile constituents, which is sufficiently proved by the very low temperature of the escaping gases, 190° C. as compared with 332° C. in the case of coke.

As regards the proportion of CO_2 and CO in the escaping gases, it appears that with coal it is much below the limit which Mr. Bell has fixed as the maximum compatible with reduction, viz. 1 of CO_2 to 2 of CO. Hence it follows that a considerable quantity of CO_2 must have dissolved carbon and so returned to CO. Calculating this quantity, it appears that the total carbon which reaches the hearth and gives up its heat for the fusion of iron, &c., is not very different in the two cases. Why then is there so large a disappearance of CO_2 in the Scotch furnace as compared with the English? Mr. Bell attributes it to the fact that the latter is 80 feet high, whilst the former, though 74 feet high, was only filled to 85 per cent. of its real capacity. The effect of the lower furnace is to diminish the time during which the ore is exposed to the reducing agency of CO, whilst still too cool for the fuel to decompose CO_2. In addition it is suggested that the presence of hydrogen in the coal might cause the formation of steam, which would subsequently react on the fuel and tend to lower the percentage of CO_2. On the whole it appears that when using raw coal in the blast furnace there is a waste of carbon to the extent of 3·72 units; but before recommending that the coal should be coked in order to avoid this loss, the commercial aspect of the question must be considered, and it appears that the cost of coking even where possible would in many cases exceed the saving attained. A further point, however, which needs consideration is the possibility of condensing the tar and ammonia given off by the coal and so saving the valuable products. Here we have a difficulty in the Scotch furnaces from the enormous quantity of gas which would have to be dealt with; nevertheless the results attained by Messrs. Baird in the Gartsherrie furnaces (given below) seem to show that the yield of ammonia is about the same as in the Simon-Carvès process for coking, as used

by Messrs. Pease, in which case the sulphate of ammonia and tar were worth about 3*s.* per ton of coal used. As theoretically five times this amount of sulphate of ammonia might be obtained from the coal, it seems probable that a large quantity of nitrogenous compounds may eventually be secured in this manner.

In the discussion on the paper, the fact of coal and coke being practically equal in heating power was confirmed by several speakers; and some interesting facts as to the anthracite blast furnaces of the United States were elicited. The advantages of calcining the limestone (which seem in most cases to be *nil*) and of mixing coke with coal in the charge were also discussed; and the important question of raw coal as an iron-smelting material may thus be said to be fairly opened.

The next two papers were taken together. The first was by Mr. R. Smith Casson on the system worked out by himself and M. Bicheroux for gas puddling and heating furnaces. This system, which has been worked with most satisfactory results in Belgium, is simpler and cheaper than that introduced by Sir William Siemens, and as regards efficiency and economy has much to recommend it. The other paper, by Mr. W. S. Sutherland, was on the most recent results in the application and utilisation of Gaseous and Liquid Fuels. It appears that Messrs. Baird and Co. are now recovering the tar and ammonia from the gases of no less than sixteen of their blast furnaces, consuming about 100 tons of coal daily. They manufacture the ammonia into sulphate and distil the tar, the actual yield per ton of coal varying from 18 lbs. to 25 lbs. of sulphate of ammonia, and from 180 lbs. to 200 lbs. of tar. The gas is found to be perfectly clean and free from moisture, and is thus better adapted than before to such purposes as raising steam, heating the blast, &c. In addition to this the paper described a new method of working the producers employed for generating gas in the Siemens or other systems of gaseous fuel, and for abstracting from the gas so obtained the tar and ammonia it comprises. It appears that a generator gas of high quality can now be got with certainty, at the same time yielding 20 lbs. of sulphate of ammonia with ten to twenty gallons of good tar per ton of coal. A net saving of from 2*s.* 6*d.* to 4*s.* per ton may thus be effected, and with the same result as in the case of the blast furnace, viz. that the gases are improved instead of being damaged by the removal of their valuable products. The using of such substances as tar and ammonia merely for fuel can only be considered barbarous, and it now seems probable that in a very few years it may be a thing of the past.

On Thursday the first paper read was by Mr. Walter R. Browne on Iron and Steel Permanent Way. It described the system of iron sleepers, successfully introduced by Mr. Webb of the London and North-Western Railway, and pointed out the many advantages that would result, especially to the iron trade of this country, if the use of metallic sleepers became a recognised fact. In Germany it is so already, thousands of miles being now laid with metallic sleepers; and it is to be hoped that a vigorous effort will be made to develop their use both in England and in our colonies.

The second paper, by Capt. C. Orde-Browne, R.A., dealt with the behaviour of Armour of different kinds under fire. Four kinds of armour were specified: first, wrought iron; secondly, compound armour or wrought iron with a steel face; thirdly, solid steel; fourthly, chilled cast iron. The different modes in which these yield to the impact of a shot were clearly described. Wrought iron is punched with a clean hole, the rest of the target hardly suffering any damage. As complete penetration is necessary, hardness and rigidity of metal are the essentials for a projectile, and not tenacity. Hence the extended use of Palliser's chilled shot. In compound armour the hard steel face severely tries the tenacity of the metal, so that the shot frequently breaks to pieces; at the same time the plate yields by cracking in radiating lines from the point of impact, and sometimes in concentric lines. Solid steel does not yield at the point of impact, but as the shot enters, it wedges and sets up the metal round it, the plate swelling and yielding by radiating cracks. Such cracks are much more likely to extend through the metal than is the case with compound plates. Chilled iron is broken up bodily by the direct blows of heavy shots, cracks radiating from the point of impact, which is never pierced even to a single inch of depth. Details were then given of the experiments carried out in 1882 at Essen, at Spezia, and at Ochta near St. Petersburg; in 1883, at Shoeburyness, and at Buckau on chilled cast iron; and finally experiments by Capt. Palliser and Sir Joseph Whitworth. Stress was laid on the necessity for dividing armour into two distinct classes, soft and hard: the former signified armour which was perforated, and the latter armour which must be broken up. The difference was illustrated by a simple dropping apparatus, in which a model of a shot with a heavy weight behind it was allowed to fall either upon millboard, to represent soft iron, or upon brick, to represent hard iron. The likeness of the results to those found in practice with hard and soft armour respectively is very remarkable. It is therefore altogether a mistake, when attacking hard armour, to use the data obtained for perforation as a measure of the shot to be employed. The energy in the shot per ton of the weight of the shield is another measure which may be useful, but is not theoretically correct. To work out the problem mathematically is very difficult, and it is suggested that much might be learnt by firing steel bullets against plates of steel and chilled iron, keeping all conditions uniform except those whose relation is the object of investigation. Certainly some such experiments are needed, as are also actual trials against the hard armour, solid steel, or chilled iron, which is much used abroad; otherwise, should we be involved in a war, we might find that our calculations, based only on soft armour, would land us in disastrous failure.

The first paper on Friday was on Recent Improvements in Iron and Steel Shipbuilding, by Mr. William John of Barrow-in-Furness. This paper gave some remarkable statistics of steel-built vessels during the last few years. It appears that between 1879 and 1883 the proportion of steel vessels built and registered in the United Kingdom increased from 4·38 per cent. in 1879 to 15·7 per cent. in 1883; wooden vessels being left out of account in each case. It is evident that steel as a material for shipbuilding has passed entirely out of the experimental stage, and must be judged by the results of its working in the shipyards, and the performance of the ships already afloat. The experience of those shipbuilders who have paid most attention to steel is that it has now become a much more uniform and satisfactory material than iron, so that workmen actually complain if they are put to work upon iron, from the trouble and annoyance it involves. The only point of practical importance left is the deterioration which occasionally occurs when thick plates of steel are punched. On this further information is necessary, as also on the real cause of the failures that took place some years ago, especially those in the boilers of the *Livadia*. In some cases, metal of which the chemical analysis showed nothing abnormal, and which would bend double when the edges were carefully prepared, broke off like glass when the edges were rough, or when holes were punched in it. The paper then went on to consider the difference in cost between vessels built of iron and steel, which at the present rate appears to be practically insignificant. On the other hand, strength is decidedly in favour of steel ships, even with the present reduction of scantlings sanctioned by Lloyd's. The case was mentioned of the *Duke of Westminster*, a vessel 400 feet long, which bumped for a week at the back of the Isle of Wight on stony ground without making a drop of water. This was owing to the elasticity of the steel, and could not possibly occur with an iron ship. With regard to corrosion, Mr. Johns considered that this was a matter to be overcome by increased knowledge and care in maintenance, while there was no evidence to show that the difference in corrosion between steel and iron is sufficient to stop the progress of steel shipbuilding. Finally he observed that great attention had been paid of late to the longitudinal strains on very large ships, much greater use being made of iron decks, longitudinal stringers in the bottom, &c., so that he could no longer show, as he had in 1874, that vessels grew steadily weaker as they increased in size. In the discussion, Mr. Martell, Inspector of Lloyd's, confirmed the view that steel is infinitely superior to ordinary iron, and that there is no reason to suppose that it deteriorates faster. He mentioned a ship built in 1878 for the iron ore trade, which as yet showed no sign of deterioration. On the other hand, Mr. Jeremiah Head mentioned that, despite the progress of steel, more iron had been used in shipbuilding during the last year than ever before, and that steel plates were still much more expensive than steel rails from the necessity of hammering them after rolling. He maintained that common iron did not corrode so much as best iron or steel: the *Great Britain*, built in 1845, is still in existence, and so is a collier built in 1831. Mr. Riley confirmed the necessity of hammering, owing to the increased number of failures if this was neglected. Sir Henry Bessemer and others also took part in the discussion. This concluded the business of the meeting, the remaining papers being adjourned.

THE BUILDING OF THE ALPS[1]

WHEN were the Alps upraised, and what is the age of their building stones? On the former of these questions there is less diversity of opinion than on the latter; yet, notwithstanding all that has been written on both, I am not without hope that I may find a few things sufficiently novel to be of interest to a general audience.

The subject, indeed, is so vast that I must crave your indulgence for leaving some gaps in my reasoning unfilled, and presenting you with little more than an outline. To save time I shall assume a knowledge of the simpler geological terms, asking you only to remember that I always use the word "schist," as I maintain it ought to be used, to denote a more or less fissile rock the constituents of which have undergone so much mineral change that, as a rule, their original nature is almost wholly a matter of conjecture. I must also ask you to remember that, though I have seldom mentioned the names of other workers, I am really doing little more than giving an epitome of the labours of a host of geologists, conspicuous among whom are Heim, Baltzer, Von Hauer, Gastaldi, Lory, Favre, Renevier, and many more, both Continental and English; I select, however, those facts with which I have myself become familiar during many visits to different districts of the Alps, from the Viso on the south to the Dachstein on the east.

It is needless, I assume, to explain that mountain chains are the result of lateral thrust rather than of vertical upheaval, and their contours are mainly due to the sculpturing action of heat and frost, rain and rivers, acting upon rocks bent into various positions, and of various degrees of destructibility. There are, however, three principles which are less familiar, but which I must ask you to bear in mind throughout this lecture: (1) that when a true schist is asserted to be the metamorphosed representative of a post-Archæan rock, the *onus probandi* lies with him who makes the assertion; (2) that rocks composed of the detritus of older rocks may often readily be mistaken for them; (3) that great caution is needed in applying the principles of lowland stratigraphy to a mountain region. The first of these is, I know, disputed, but there can be little doubt as to its accuracy; the second is indisputable, so is the third; but I will briefly illustrate what I mean by the statement. [Attention was then directed to diagrams of folds and reversals of strata in the Alps.]

The first section to which I invite your attention is in the neighbourhood of the Lake of Lucerne. There are few travellers to whom the cliffs of the Rigi are not familiar. Those great walls of rock, along and beneath which the Rigibahn now takes its audacious way, are mainly composed of enormous masses of conglomerate, an indurated gravel of Miocene age, called the nagelflue. These pebble beds may be traced in greater or less development along the north-western margin of the Swiss Alps; they attain in the Rigi and the fatal crags of the adjoining Rossberg a thickness of not less than 2000 feet. The structure and nature of this nagelflue show that it has been deposited by rivers, possibly at their entry into lakes, but more probably, as suggested by my friend Mr. Blanford, on beginning a lowland course at the very gates of the mountains. In this great mass there are indeed pebbles of doubtful derivation; but we need not hesitate to refer the bulk of them to the mountains which lie towards the east, and we may regard the great pebble beds of the Rigi and the Rossberg as built of the ruins of Miocene Alps by the streams of a Miocene Reuss. Now when we scrutinise the pebbles of this nagelflue we are at once struck by a remarkable fact. The Reuss, at the present day, only passes through Mesozoic rocks when it approaches the neighbourhood of the Lake of Lucerne. It is within the mark to say that quite three-fourths of its drainage area consists of crystalline rocks. Hence schists and gneisses abound among its pebbles, and the same rocks are no less frequent among the erratics which have been deposited by the vanished glaciers of the Great Ice Age on the flanks of the Rigi to a height of 2000 feet above the Lake of Lucerne. Yet, on examining the nagelflue, we find that, while pebbles of grit, and limestone, and chert—specimens of the Alpine Mesozoic rocks—abound, pebbles of schist and gneiss are extremely rare. I had searched for hours before I found a single one. The matrix also of the nagelflue—the mortar which makes this natural concrete—when examined beneath the microscope, tells the same story. We do not see in it the frequent quartz grains, the occasional pieces of felspar, the mica flakes, which are records of the detrition of gneissic rocks, but it consists of fragments similar to those which form the larger pebbles. It is therefore a legitimate inference that, in this part of the Alps at least, the protective covering of Mesozoic rock in the Miocene age had not generally been stripped away from the crystalline schists of the Upper Reuss, and that since then the mountains may have been diminished and the valleys deepened by at least a mile vertically. I have spoken only of the valley of the Reuss, but a little consideration will show that my remarks may be extended to a much larger area of the Oberland Alps.

I pass now to two other sections: of these the first is in the neighbourhood of Pontresina. Most of the peaks in this region consist of igneous rocks, of gneisses, and of schists, but some of later date are not wanting—as, for example, may be seen in the flanks of the well-known Heuthal. These last are limestones of Triassic age. Here they overlie unconformably a coarse gneiss—in other places they rest on schists presumably of later date; in fact, the series of Mesozoic rocks of which the above limestone is the lowest member—though now to a great extent removed by denudation—has clearly once passed transgressively over the whole series of gneisses and schists of the Engadine.

The second section, or rather group of sections, is some distance away to the south-east, in the region of the Italian Tyrol. Those magnificent crags of the Dolomite mountains, the serrate teeth of the Rosengarten and the Langkofel, the towers of the Cristallo and the Drei Zinnen, the precipitous masses of the Blattkogel and the Marmolata, are built up of rocks of Triassic age, not of a very different date from the soft red marls which occupy so large an area in the Midlands of England. Follow me for one moment by the mountain road from Predazzo to Primiero. At the former place—classic ground for geologists—we are surrounded by great masses of igneous rocks, the roots, it may be, of long-vanished cones, although we refuse to recognise a crater in the valley about Predazzo. As we ascend towards the beautiful Alps of Paneveggio, we pass for a considerable distance over a great mass of red felstone. This belongs to a group of igneous rocks which extend to the westward even beyond the Etsch. It is overlain by the beds of the Trias, commencing with the red Grodner sandstone and passing up soon into the vast masses of dolomite which form the wild crags of the Cimon della Pala and its attendant summits. But as we descend on the other side of the pass towards Primiero, we see the Triassic rocks, without the intervention of the felstone, resting upon mica schists, similar to those which occur in many other parts of the Alps. Sections of the above kind, were it needful, might be multiplied indefinitely to prove that between the base of the Trias and the Alpine schists and gneisses there is an enormous break, but we may content ourselves with one other, interesting not only for the completeness of the demonstration, but also for the mode in which it illustrates Alpine structure. [Attention was then directed to the section of the Mont Blanc range as given by Prof. Favre.]

The Aiguilles Rouges are composed of coarse gneisses and crystalline schists, but on the highest summit there remains a fragmental outlier of stratified and unaltered rock. The upper part of this is certainly Jurassic. Below this comes a representative of the Trias—much attenuated, as it is generally in this western region, with possibly a remnant of a deposit of Carboniferous age. Be that as it may, there is undoubtedly here a great break between the crystalline series and the succeeding Mesozoic or Palæozoic rock.

There remains yet one other section to which I wish to direct your attention; it is near Vernayaz, in the vicinity of the famous gorge of the Trient. Where the Rhone bends, at Martigny, from a south-west to a north-west course, the crystalline *massif* of the Mont Blanc region of which we have just spoken crosses the river, and is lost to sight as it plunges beneath the Mesozoic rocks of the western summits of the Oberland. The gorge of the Trient is cut through hard and moderately coarse gneiss; the same rock occurs at the Sallenche waterfall. Between the two is a mass of rock of a totally different character—in part a dark slate, like some in Britain of Lower Silurian age; in part a conglomerate or breccia in a micaceous matrix, proved by its plant remains to be a member of the Carboniferous series. Omitting some minor details, not without interest, it may suffice to say that we have in this place the end of an almost vertical loop, formed by the folding of beds of Carboniferous age between the crystalline rocks, which are the foundation-stones of the district. The conglomerate is at the base of the Carboniferous

[1] Lecture by Prof. T. G. Bonney, D.Sc., F.R.S., Pres.G.S., at the Royal Institution, April 4.

series, and its matrix so closely resembles a mica schist that it has been claimed as indicating metamorphism, and as linking together the Carboniferous slates and the crystalline schists. But, in the first place, the fragments in the conglomerate are not only gneisses and schists, but also ordinary slaty rocks, no more altered than those of Llanberis. How, we may well ask, could the latter escape unchanged when all the surrounding matrix was converted into mica schist? Further, when we apply the test of the microscope—that Ithuriel spear by which the deceits of rocks are so often revealed—we find that this seeming mica schist is only the consolidated debris of micaceous rocks. Its composition, and that of the conglomerate, justifies us in asserting that when the Carboniferous rocks of the Valorsine were deposited there were land surfaces of gneiss and schist in the western region of the Alps, and that these rocks were substantially identical with those through which the Trient has sawn its ravine.

It would be easy to multiply instances similar to one or the other of those quoted above for this or that district of the Alpine region, from the south of Monte Viso to the north of the Adriatic, to speak only of those districts of which I have a personal knowledge; but I should speedily weary you, and will ask you to regard these as typical cases, single samples of a great collection. They justify, as I think you will agree, the following inferences:—(1) That there has been one epoch, at least, of mountain-making posterior to the deposition of the Miocene nagelflue, which has given to many parts of the Alpine chain an uplift sometimes not less than a mile in vertical elevation; (2) that prior to this there was an earlier epoch of mountain-making, which affected all the rocks of older date, including at any rate a portion of middle Eocene age—for we find marine strata of this date crowning the summit of the Diablerets, now more than 10,000 feet above the sea, and bent back, as at the Rigi Scheideck, over the beds of the nagelflue; (3) that there was a pre-Triassic land surface of great extent, largely composed of crystalline rocks, and that with this geological age commenced a long continuous period of depression, lasting into Tertiary times; (4) that a land surface of considerable extent existed at a yet earlier period, and that this in the Carboniferous age was watered by streams and clothed with vegetation—whether there were mountains then it is impossible to say, but the evidence certainly points to the conclusion that the ground was hilly; (5) that anterior to the last-named period there is a great gap in our records; the older rocks, whose stratigraphical position can be ascertained, being much metamorphosed, so that we appear justified in concluding that all the more important mineral changes which they had undergone occurred in pre-Carboniferous times—that is, that the later Palæozoic land surfaces consisted of gneiss and schists in all important respects identical with those which now exist.

I have thus led you step by step—by processes, I trust, of cautious induction—to the result that the Alps, as an irregular land surface, are a very ancient feature in the contour of the earth, and that the gneisses and crystalline schists, whereof they so largely consist, are rocks of very great antiquity. Let us now attempt to advance a step further by attacking the problem from another side. Hitherto we have been working downwards from the newer to the older, from the rocks of known towards those of unknown date. Beginning now in the unknown, beginning with the most remote that we can find, let us proceed onwards toward the more recent and more recognised.

This is a task of no slight difficulty. The ordinary rules of stratigraphical inference frequently fail us; nay, if blindly followed, would lead us to the most erroneous conclusions. In the apparent succession of strata in a mountain range the last may be first and the first last in the literal sense of the words. Beds may be repeated again and again by great folds, now in the direct, now in the inverse, order of their superposition. They may have been faulted and then folded, or folded and then faulted, and the difficulty is augmented by the vast scale on which these earth movements have taken place, by the frequent impossibility of scaling the crags or pinnacles where critical sections are disclosed, and by the masking of large areas of surface by snow and glacier, or by debris and vegetation. Yet more, the consciousness of these difficulties produces in the mind—I speak for myself—a sort of hesitation and scepticism, which are most unfavourable for inductive reasoning. Knowing not what features are of importance, one is perplexed by the variety of facts that seem to call for notice; knowing how easily one may be deceived, one hesitates to draw conclusions. I am often painfully conscious of how much I have lost in a previous journey from not having remarked some fact to which a fortunate accident has just compelled my attention. In this part, therefore, I must be pardoned if I speak with considerable hesitation and do not attempt more than state those inferences which seem to me warranted by facts.

I shall again ask permission to conduct you to a series of typical sections, which, however, I shall describe with less minuteness.

Let us place ourselves in imagination on the great ice-field at the upper part of the Gross Aletsch Glacier—the Place de la Concorde of Nature, as it has been happily termed. We are almost hemmed in by some of the loftiest peaks of the Bernese Oberland: the Aletschhorn, the Jungfrau, the Mönch, and several others. We find the rocks which rise immediately round the glacier—as, for example, near the well-known Concordia hut—to be coarse gneisses, with difficulty distinguishable from granites. As the eye travels up to any one of the mountain ridges, the rock evidently becomes less massive and more distinctly foliated. We note the same sequence as we retrace our steps towards the Rhone valley—speaking in general terms, the ridges and the flanks of the Eggischhorn consist of more finely granulated gneisses and of strong micaceous schists, which alternate more frequently one with another. Further to the west, in the region around the Oberaletsch Glacier and on the slopes of the Bell Alp, we find the same succession—coarse granitoid gneisses in the relatively lower part of the heart of the chain, finer grained and more variable gneisses and schists on the upper ridges and the southern flanks.

Let us change our position to a spot considerably to the east, to the great section of the crystalline series made by the valley of the Reuss below Andermatt.

From the spot where the rocks close in suddenly upon the torrent near the Devil's Bridge, to a considerable distance below Wasen, extends an almost unbroken mass of coarse granitoid gneiss. This, however, becomes more distinctly bedded and schistose before it entirely disappears beneath the Secondary deposits that border the Bay of Uri. Similarly, if from Wasen, where the gneiss is barely distinguishable from granite, we ascend the wild glen which leads up to the Susten Pass, and descend on the other side by the grand scenery of the Stein Alp to the beautiful Gadmenthal, thus passing obliquely outwards along the apparent strike of the rocks to the point where, as in the neighbourhood of the Imhof, they disappear beneath Mesozoic deposits, we again find that we are among rocks which are rather more variable in their mineral character, oscillating between moderately coarse gneisses, sometimes porphyritic, and strong mica schists. Near Muhlestalden, in the Gadmenthal, even a bed of white crystalline dolomitic limestone is interstratified with the gneissic rocks.

Leaving for a brief space the vicinity of the St. Gothard road, and returning to the upper valley of the Rhone, let us place ourselves on such an outlook as we can obtain from Prof. Tyndall's châlet on the Bell Alp, and fix our eyes on the magnificent panorama of the Pennine chain, with whose geology we will suppose ourselves to have become familiar in frequent traverses from the northern to the southern side of the watershed of Central Europe. Facing us, and forming the lower slopes and crags of the great mountain chain of the Pennines, we see an enormous mass of distinctly bedded rock, of a brownish tint, of which at this distance we should hesitate to say whether we ought to regard it as a member of the metamorphic or of the ordinary sedimentary series. In an east-north-east direction we see it gradually rising to form the peak of the Ofenhorn and the upper part of the mountains about the Gries Pass. In the opposite direction it forms the lower slopes of the Simplon Pass and the portals of the valley of the Visp. Hence, could we follow it, the area occupied by this rock broadens out into the spurs which inclose the Einfischthal and the Eringerthal, and crosses the watershed towards the south to the east of the St. Bernard Pass. In more than one locality in the region of the Binnenthal a band, of no great vertical thickness, of a white crystalline dolomite is conspicuously present. A very similar group of rocks occurs in the Val Piora, in some bands of which black garnets are very abundant. The same mineral also occurs in a similar rock near the summit of the Gries Pass. Andalusite or staurolite also occurs occasionally; the group, in short, is well characterised, and for reference I will call it the Lustrous Schists.

I pass now to the neighbourhood of the St. Gothard. The coarse gneiss, which is pierced by the northern entrance of the great tunnel, ends abruptly at the Urnerloch. The basin of the Urserenthal is excavated from satiny slates, with dark limestones, very possibly of Jurassic age, and from some underlying rather variable schists. The first rock visible on the eastern side as we approach Andermatt is a schistose crystalline limestone, associated with mica schists; and a series of rather variable schists, evidently very different from the coarse gneisses of the gorge below, appears to cross the valley, and form the slopes leading to the Oberalp Pass. These may be traced for some distance up the Furka road above Realp, when they are abruptly succeeded by the slaty group mentioned above. I am convinced that they are much more ancient than the latter, being probably members of the Lustrous Schist group, if not older. It is obvious that the newer rocks are only a fragment of a loop of a huge fold, over which on either hand the fragments of the enveloping older metamorphic rocks tower up in mountain peaks. On the ascent of the St. Gothard Pass from Hospenthal a series of somewhat variable micaceous schists continues till the top of the first step in the ascent is reached, about 800 feet above the valley, when gneiss sets in, generally rather coarse and sometimes very porphyritic, occasionally interbanded with dark, rather friable mica schists. The upper plateau of the pass consists of a porphyritic rock, often called granite, but with a gneissose aspect and rather more friable in character than the rock of the Wasen district. On the first steep descent on the south side this rock appears to pass into a normal coarse gneiss, occasionally banded with mica schist, resembling that in a similar position on the northern flank, which is succeeded for a short space by a remarkably well-banded gneiss. To this succeeds—it must be remembered that the series is inverted in order—the great group of hornblendic and garnetiferous mica schists, which continue along the Val Tremola and the lower slopes of the mountain to the neighbourhood of Airolo, where some calcareous rock occurs, being probably an infold of much later date.

Through the kindness of Mr. Fletcher and Mr. Davis, of the British Museum, I have been allowed to examine the series of specimens from the St. Gothard Tunnel in that collection. They correspond in general with the succession above indicated, except that I have failed to identify the granitoid rock of the summit plateau. Leaving, however, for a moment the question of correlation, we see that the St. Gothard section presents us with an instance of folding on a gigantic scale, and of the fan structure, doubtless with many minor flexures and faults.

In the neighbourhood of the Val Piora we get an important succession. The ascent to the hotel from the Val Bedretto passes in the main over a series of micaceous schists and rather friable gneisses, which are a prolongation of an axis exposed in the mountains south of Airolo and fairly correspond with much of the rock (excepting the granitoid) forming the upper part of the St. Gothard Pass. To this succeeds a series which, though more calcareous, clearly represents the garnetiferous actinolitic series of the southern slopes, and to this a group closely resembling the Lustrous Schists.

(To be continued.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The Electors to the Professorship of Pathology will meet for the purpose of electing a Professor on May 24. The stipend of the Professor is 800*l.* a year, exclusive of fees, but he must not engage in the private practice of Medicine or Surgery.

Prof. Macalister lectures to-day on the Race Types of the Human Skull; on Saturday, on the Race Variations of the Skin, Hair, and Soft Parts; and on Tuesday, the 13th, on the Anatomical Characters of the Prehistoric and Early Historic Races of Britain: on each day at 1 p.m.

In the Long Vacation Prof. Macalister will take a Class in Osteology, and the Demonstrator will have a class for Practical Histology.

The new buildings for Prof. Stuart's Museum of Mechanism will be ready to receive their contents this term, and it is recommended that the buildings to provide for the Department of Botany be at once proceeded with, to be ready for use at the beginning of October.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, May 1.—"On the Connection of the Himalaya Snowfall with Dry Winds and Seasons of Drought in India." By Henry F. Blanford, F.R.S.

In this paper the author points out that for some years past it has been suspected that the snowfall of the Himalaya has a direct influence on the dry land winds of North-Western India. The connection of the two was first noticed in 1876 and 1877, the first-named a year of drought and famine in Southern India, the second the same in the North-Western Provinces, Rajputana, and Central India. Messrs. Hill and Archibald, about the same time, called attention to the circumstance that excessive winter rainfall in Northern India is usually followed by defective rains in the summer or monsoon season. This inference is strengthened if the rainfall of May be included in that of the winter and spring instead of in that of the summer, as is shown by a table for the eighteen years from 1864 to 1881 inclusive. Fourteen of these years give results agreeing with Messrs. Hill and Archibald's views, and only four differ from their conclusions: two out of these four, viz. 1876 and 1880, being found on further investigation distinctly to confirm the theory, whilst data are wanting with regard to the other two years.

After some details concerning the meteorology of the area in the years 1881-82, the writer gives a description of the unusual snowfall on the outer ranges of the Himalaya in the spring of 1883, and of the extensive drought in Northern, North-Western, and part of Central India that followed. In this instance a warning forecast of dry weather and retarded rainfall was published in the *Gazette of India* on June 2, and this forecast is shown to have been justified by the event, the rainfall in July and August over large portions of India having been much below the average.

In an account of the meteorology of the land winds it is shown that from November to February they tend to circulate anticyclonically round the axis of maximum pressure, extending from the Punjab and Sind across Rajputana and Central India towards Orissa. In March a barometric minimum is established over the Hyderabad plateau, and this extends to the north and north-east, the wind currents becoming cyclonic around the depression. To the eastward of this area some rain falls in the spring, but Western India from Belgaum to the Punjab is practically rainless from November till May, and is the dry wind area. It is then shown that the supply of air for the dry wind is derived from an upper stratum by convective interchange. After rain and snow on the Himalayas the dry winds are supplemented by an outflow of cold air from the hills accompanied by a wave of high pressure advancing eastward from the valley of the Indus.

The following summary and conclusions are given:—

(1.) The experience of recent years affords many instances of an unusually heavy and especially a late fall of snow on the North-Western Himalaya being followed by a prolonged period of drought on the plains of North-Western and Western India.

(2.) On tabulating the average rainfall of the winter and spring months at the stations of the North-Western Himalaya, year by year, for the last eighteen years, and comparing it with the average rainfall of the North-Western Provinces in the ensuing summer monsoon, it is found that with four exceptions an excessive winter precipitation on the hills is followed by a deficient summer rainfall on the plains, and *vice versâ*. Of the four apparent exceptions, two are found to afford a striking support to the first proposition.

(3.) The west winds which, in Western and Northern India, are characteristic of seasons of drought as abnormal winds, are identical in character with the normal winds of the dry season, and appear to be fed by descending currents from the North-Western Himalaya, and possibly the western mountains generally.

(4.) It is a common and well-known phenomenon of the winter months that a fall of rain and snow on the North-Western Himalaya is immediately followed by a wave of high pressure advancing eastwards from the western mountains, accompanied with dry cool north-west winds.

(5.) The conclusion is that an unusual expanse of snow on the North-Western Himalaya, whether due to the unmelted residue of an unusually copious winter snowfall, or to an unusually late fall in the spring months, acts, at high levels, in the summer months, in somewhat the same way as the ordinary falls of snow and rain on the Lower Himalaya do at low levels in the winter

season, and favour the production of dry north-west winds on the plains of Western India.

(6.) That this dependence of dry winds on the Himalayan snowfall affords a criterion for forecasting the probabilities of drought in North-Western and Western India.

In setting forth the above conclusions, it is, however, necessary not to ignore the fact that there are other conditions besides those here considered which exercise a very great influence on the prevalence of dry winds and drought. During the last famine period in India (the years 1876 and 1877; in the former year in Southern India, in the latter in the North-Western Provinces and Rajputana), the pressure of the atmosphere was persistently and abnormally high, and this was due, as I showed in the reports on the meteorology of those years, to the condition, probably the high density, of the higher atmospheric strata. Moreover, this excessive pressure was shown to affect so extensive a region that it would be unreasonable to attribute it to the condition of any tract so limited as a portion of the Himalayan chain; and if dependent on the thermal conditions of the surface, which may indeed have been the case, this land must rather have been the major portion of the Asiatic continent than merely a relatively small portion of its mountain axis. This question must remain for future inquiry. It is referred to here to guard against too wide an application being assigned to the action of the Himalayan snows.

Physical Society, April 26.—Dr. Guthrie, president, in the chair.—New Members: Mr. Chattock, Mr. Inwards.—Profs. Perry and Ayrton read a paper on the indicator diagram of a gas-engine, which was intended to teach practical engineers a new method of studying gas-engine diagrams. The most recent results obtained by the use of Dowson gas were stated, and it was suggested that before long gas-engines will be employed for the propulsion of ships. A large wooden model of an Otto gas-engine enabled the operations going on during a cycle of the engine to be understood. Tables were given of the constituents of coal-gas and Dowson gas, the air required for combustion, the heat of combustion, and the specific heats, to enable the characteristic equation of the fluid used in the gas-engine to be determined. An easy method of obtaining one empirical formula to represent all the diagrams which can be obtained from an engine with different quantities of gas was described and its results compared with observation. The effects of vibration of the indicator spring in the various parts of the diagram were discussed, as well as the effect of the last explosion, which are provided for in the empirical formula. Three practical methods of determining the rate, q, of gain of heat by the fluid during the forward stroke were given, and a diagram was shown in which this rate could everywhere be compared with the rate of doing work. If W is the indicated work in one cycle, it was shown that 5·64 W is the total energy of combustion of one charge, and this is expended as follows:—1·45 W is the work done in the forward stroke, 2·22 W is given to the cylinder by radiation in the forward stroke, 1·5 W is carried off through the exhaust-pipe, 0·47 W is given to the cylinder as heat after exhaust-valve opens. The rate at which the loss, 2·22 W., by radiation occurs at every point of the forward stroke was shown on a diagram obtained from a knowledge of the temperature at every point in the stroke, and when the ordinates of this diagram were added to the q diagram previously described, a diagram was obtained showing at every point of the stroke the rate at which combustion was going on. This diagram was specially important as showing the effect of dissociation in the gas-engine.—Dr. W. H. Stone exhibited a simple form of siphon mercurial barometer with metrical scale. Two millimetre scales are adjusted to slide easily side by side; the lower edge of one is brought on a level with the mercury in the shorter limb, and the other slid up and down until its lower edge coincides with the upper mercury surface. The adjustment is easily effected by an ob erver without stooping by the use of two right-angled glass prisms fitting on the upper and lower ends of a vertical glass tube.—The next meeting of the Society, on May 10, will be held in the Mason College, Birmingham.

Anthropological Institute, April 22.—Prof. Flower, F.R.S., president, in the chair.—The President, in welcoming the Members to their new quarters, gave an outline of the history of the Society and of the eminent men who have presided over it during the forty years of its existence. The Ethnological Society, founded in 1843, and the Anthropological Society twenty years later, were united in 1871 under the title, "The Anthropological Institute of Great Britain and Ireland."—The Marquis of Lorne sent to express his regret at his inability to attend; he exhibited a large collection of North American objects, including a scalp taken last summer.—Sir Richard Owen communicated a paper on a portrait of an aboriginal Tasmanian. The paper was further illustrated by two busts and several portraits belonging to the Institute.—Prof. Keane then read a paper on the ethnology of the Egyptian Soudan, which was described as a region of extreme complexity, a converging point of all the great races of the African Continent, except the Hottentot and Bushman. Although official documents such as Col. Stewart's "Report on the Soudan" for 1883, recognised only "two main divisions, Arab and Negro," it was shown that here was represented the Hamites, Semites, Nubians, Negroes, and Bantus. Of the Hamites, the chief branches were the Tibbu in Darfur, and the Ethiopians stretching east of the Nile without interruption from Egypt to the Equator, and including the Galla and Somali south of Abyssinia, various tribes between Abyssinia and the coast, and the Bejas, who occupied the greater part of the Nubian Desert between Abyssinia and Egypt. The Bejas, whose very existence was ignored by our officials, and who were universally confounded by newspaper correspondents with the Arabs, were the true aboriginal element in the country between Berber and Suakim, where they recently came into collision with the British forces.

Royal Microscopical Society, April 9.—The Rev. W. H. Dallinger, F.R.S., president, in the chair.—On the motion of the President a vote of condolence with the R. Accademia dei Lincei on the death of their president, Quintino Sella (an *ex-officio* Fellow of the Society) was passed.—Dr. Carpenter, C.B., explained in detail his reasons for considering that binocular vision in the microscope took place on the same principles as in the case of ordinary vision, and combated Prof. Abbe's view to the contrary. A number of photographs, diagrams, and models were exhibited in illustration. Mr. Crisp gave his reasons for considering that Prof. Abbe was right. In ordinary vision we had a perspective shortening of parts of the object, but under the microscope this did not occur. In ordinary vision a lined object would show the lines closer together when viewed obliquely, whilst under the microscope the lines appeared the same distance apart whether they were viewed by the central or oblique pencils.—Mr. Bolton exhibited the interesting Rhizopod, *Clathrulina elegans*, from Epping Forest, which had been found to exhibit a fourth mode of reproduction by the formation of flagellate monads.—Mr. Guimaraens described a true *Xanthidium* from Halifax coal strata.—Mr. Badcock read a note on certain filaments which he had observed protruding from *Surirella bifrons*.—Mr. Nelson explained the method which he had found most suitable for examining certain bacteria.—The President announced that the next meeting would be made special, to consider the question of the admission of ladies as members of the Society.

PARIS

Academy of Sciences, April 28.—M. Rolland in the chair.—Observations extracted from M. Verbeek's report on the Krakatoa eruption of August 26, 27, and 28, 1883, by M. Daubrée.—Note on the problem to determine the degree of all algebraic surfaces which may be osculatory with another surface, by M. de Jonquières.—On an extension of the law of Harriot relating to algebraic equations, by Prof. Sylvester.—Memoir on the conservation of stellar energies, and on the variation of terrestrial temperatures, with a table showing the probable succession of the approximate dates of maximum and minimum intensity of solar radiation, by M. Duponchel.—On the absolute standard of light, by M. J. Violle. In this paper the author develops the idea already formulated by him at the International Congress of Electricians in 1881, the essential object of which was to verify the principle of the method, which consists in taking as a standard of light a metal at its point of fusion. He now finds that platinum best fulfils the conditions required of an absolute standard of light. It rests on a perfectly defined and constant physical phenomenon, and constitutes a practical term of comparison with ordinary standards.—Results of a series of experiments undertaken to determine the dimensions of the column of mercury at zero which represents the unity of practical resistance, or the value of the ohm, by MM. E. Mascart, F. de Nerville, and R. Benoit.—Note on the application of the laws of induction to the helio-electric theory of the perturbations of terrestrial magnetism, by M. Quet From his own observations, as well as those of Carrington, Arm strong, and others, the author infers a definite relation between

the sunspots and terrestrial magnetic disturbances.—On the apparent resistance of the voltaic arc usually employed in lighthouses, by M. F. Lucas.—Some results of repeated experiments conducted at the School of Telegraphy on telluric electric currents, by M. E. E. Blavier.—Description of a method for directly determining the cause of the deficit in dynamo-electric machines, by M. G. Cabanellas.—On the freezing point of the salts of biatomic metals, by M. F. M. Raoult. This paper is accompanied by tables of results for a large number of biatomic metals.—On the formation of amides in separating sal ammoniacs from organic acids, by M. N. Menschutkin.—On a glucoside yielded by the Boldo (*Boldoa fragrans*), by M. P. Chapoteaut.—Researches on water-tight substances: influence of baking and carbonic acid on the induration of siliceous cements, by M. Ed. Landrin.—On the presence of manganese in wines and a large number of other vegetable and animal products, by M. E. J. Maumené. An appreciable proportion of manganese was found in thirty-four wines tested by the author, who infers that it exists in all wines, as well as in wheat, rye, and many other substances.—Note on the assimilating properties of the phosphoric acid contained in rocks and in arable lands, by M. G. Lechartier.—Experimental method of determining the physiological combustibility of various substances, with tabulated results, by M. Schützenberger.—Researches on the respiration of plants in the dark, by MM. G. Bonnier and L. Mangin.—Further remarks on the zeolites associated with the dolerites of the Chaux-de-Bergonne district, Puy-de-Dôme, by M. F. Gonnard.—Special distribution and localisation of the motor roots in the lumbo-sacral plexus, by MM. Forgue and Lannegrace.—Geological section of the shaft sunk to a depth of 502·50 metres at Montrond, Loire, presented by M. Laur. At this depth a sheet of mineral water was reached, accompanied by much carbonic acid, which was ejected to a height of 35 metres above the surface.

BERLIN

Physiological Society, March 28.—Dr. Cohnstein communicated observations he had made on rabbits and dogs regarding the nature of the blood of fœtuses and new-born animals. He first counted the number of blood-corpuscles in a cubic millimetre of blood, and found that throughout the whole course of the fœtal intra-uterine state they increased progressively with the age of the embryo, but yet never attained to the number present in the mother's blood. After birth, however, the relative numbers of the two were reversed. The number of blood-corpuscles in the blood of the young one exceeded that in the blood of the mother. The blood of the new-born animal was accordingly thicker than that both of the fœtus and of the mother. Dr. Cohnstein measured the total blood mass in the unborn and new-born young according to a method he communicated in greater detail; and though the results he obtained were very variable, he never found the same relative differences therein as applied to the quantity of blood-corpuscles. The proportion of hæmoglobin of the embryo blood was precisely calculated, and on the whole showed the same variations as the number of blood-cells; yet the increase of hæmoglobin after birth was not so great as that of the number of blood-corpuscles.—In connection with the foregoing statements of Dr. Cohnstein, Prof. Zuntz brought forward his experiments on the subject of the mechanics of the blood-circulation in unborn animals, after describing at full length the apparatus and methods he had employed in this investigation. The results of his observations, carried out mostly on the umbilical vessels, were as follows:—The blood-pressure in the navel artery amounted on an average to about 40 mm. mercury; in the navel vein it showed very considerable variations, limited, however, to between 16 and 30 mm. mercury; values very considerably surpassing the normal pressure in the *vena cava inferior* in the case of the full-grown, but which were very simply explained by the fact that the blood in the placenta suffered only very slight resistance. The rate of movement of the blood was considerably less in the fœtus than in the mother. Especially interesting were the results of the analyses of the blood gases, performed in accordance with methods indicated in the address. It was first shown that the blood of the unborn, when kept for some time in a closed vessel, had its proportion of oxygen very quickly reduced, that is to say, the consumption of oxygen on the part of the fœtal blood was very copious and considerably greater than after birth or in the case of the full-grown. This fact was shown by the very appearance of the blood, the bright red blood taken from the navel artery turning dark very rapidly. The proportion of carbonic acid in the blood in the navel artery was about 4½ per cent. higher than in the navel vein, while in the case of the full-grown the difference between arterial and venous blood amounted on an average, as was well known, to 9 per cent. The proportion of oxygen in the fœtal blood was very changing. In the navel artery it averaged about 4 per cent. less than in the navel vein; but even in this latter case the blood was by no means saturated with oxygen. From the gaseous contents of the blood and its circulation an interesting glance was thus obtained into the respiratory process of the unborn.—Dr. Kossel announced that he had succeeded in demonstrating the presence of peptonous bodies in tissue. If the granule-holding blood-cells of birds were treated with water, there remained a loose, flaky mass which shrunk together on the application of hydrochloric acid; the main constituent of the flaky mass was nuclein, and by the acid another substance was freed, which on analysis proved to be a peptonous substance. The circumstance that this peptonous body, which was soluble in water, was not extracted on the first treatment with water, showed that in the blood-corpuscles it was chemically combined with nuclein. A remarkable property was displayed by this peptonous body when treated with ammonia; it became precipitated as coagulable albumen. Such a transformation of a peptone into coagulable albumen was hitherto known only as an effect of high temperature. That it could be effected in such a simple manner Dr. Kossel regarded as a confirmation of his view that peptone was distinguished from albumen by a higher proportion of water.—Herr Aronsohn spoke of his experiments with a view to electric irritation of the olfactory nerves. The nose having been filled with a very weak warm solution of common salt, one electrode, a platinum wire inside a glass tube, was brought close to the olfactory nerve, and the other was directed to the hand or the neck. A constant current of the strength of ·0001 ampere now excited in each case, according to its direction, either on opening or on closing, a quite decided sensation of smell which could be compared with no known scent, not even with that of phosphor or ozone. Now and again, too, a sense of taste was excited at the same time. The direction of the current had no influence on the quality of the olfactory sensation. The appearance of the irritation on closing or opening the constant current corresponded completely with Pflüger's law of spasms (*Zuckungogesetz*).

CONTENTS

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n
s
r
s
e
of
e,
d
of
n,
of
en
se
he
n.
n-
of